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[OFFICIAL NOTICE.]

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

The annual meeting of the Association will be held at the Tremont House, Boston, on Wednesday, February 19th, 1879, at 12 o'clock, noon.

Members intending to propose any persons for membership at the annual meeting, are requested to send to the Secretary the names of such persons as soon as possible.

GEORGE B. NEAL, *Secretary.*

BOSTON, Jan. 14th, 1879.

PAPER ON ELECTRIC LIGHTING.—At the Meeting of the Society of Civil Engineers, on Feb. 5th, inst., Mr. Chester will read a Paper on "Electric Lighting." Members of the Society interested in the subject are requested to attend, and bring with them friends who may desire to be present.

104 E. 20th Street, New York, *February 1st*, 1879.

JOHN BOGART, *Secretary A.S.C.E.*

MAKING UP ACCOUNTS.

During the month just closed most of the gas managers have doubtless been engaged in making up their annual reports; and, so far as we have been able to learn, the final balance goes to confirm the opinion expressed at the beginning of the year, that, in the vast majority of cases, the "turn" seems to have been reached, and results are *better*.

To whatever cause this may be attributed it seems to be a fact that the worst is over, and better times have commenced.

The past few years have taught some practical lessons in economy of management, and closer working, that should not soon be forgotten. In many companies reduced consumption has enforced a reduced expenditure beyond that due merely to the reduction in amount of gas sold. This has certainly been the case at the retort-house end of the business; and it is to be hoped that it is equally true of the office portion of the company's expenses.

It is to be very much regretted that we have not been able to record many cases of a reduction in the amount of capital stock with which many companies are still saddled. Works built in times of high prices, and, in addition to this, too often carrying an amount of watered stock sufficient to drown any business, are still staggering under the load, and the stockholders, while asking for their dividends, are ever anxious to know why the engineer cannot make his gas a little cheaper, to enable the board to declare a little larger dividend. Now is a good time to resume; that is, get down to a solid basis, where the capital is in excess of a fair valuation of the plant, and then make every effort for extending the business. In fact, conduct the affairs on exactly the same basis as any other manufacturing enterprise is conducted—seeking all the consumption it is possible to get, and keeping all that they obtain.

One great benefit that has flowed from the electric light scare is that it seems to have awakened some of the sleepers, and it is to be hoped they will not drop off again. The London *Journal of Gas Lighting*, of Jan. 14, thus speaks upon this point, regarding the benefits to gas companies resulting from the electric light agitation:

"The electric light may, at the present time, almost be considered dead; but at all events, it has had one very good effect, it has roused the gas companies; and not the least consequence is the display by the Phœnix Company, which clearly demonstrates that gas can successfully compete with electricity.

"The Phœnix Gas Company, under the direction of their Engineer, Mr. Corbet Woodall, made a bold experiment on Saturday evening last. They confronted the electric light with Mr. Sugg's new burners, and we may be excused for expressing a strong opinion, that the new burners give a superior light to that afforded by the electric lamp. We can express an unqualified opinion that the lights, as exhibited at the corners of Stamford Street, York Road, and the "refuges," were superior to the electric light. Taking it altogether, the experiment made by the Phœnix Gas Company is eminently successful. It is satisfactory to learn that the cost of this greatly improved illumination is not much in excess of the old system. Of this more will be said anon, when we possess fuller details; but whatever it may be, if the interests of the travelling public be considered, we are perfectly certain the authorities will be in favor of the light afforded by the gas company. The beauty of the light and its diffusibility cannot be disputed. Demonstrations of a similar kind are shortly to be made by the Chartered Company."

Extending the Use of Gas.

The Chartered Company are applying for power to "manufacture, provide, purchase, sell, and lend, or let for hire, any gas or other fittings, engines, stoves, pipes, and other appliances for motive power, or lighting, warming, or ventilating houses and buildings, for the cooking of food, and for all or any other purposes for which the consumption of gas, or any product obtained in the manufacture of gas, can or may be used."

These are broad powers, and do not seem to indicate that the "old chartered" company at least intend to "throw up the sponge" just yet. With their immense territory at Beckton, which is none too large for the prospective wants of the company, they will, in a short time, if these powers are granted, be able to rival the Paris company, in the manufacture of all their residual products, as well as the necessary apparatus of a large establishment like theirs.

The London Company and the Crystal Palace Company are also applying for similar enlarged powers, to furnish all the appliances necessary for the consumption of gas in houses, and also to furnish engines and machines, the motive power of which is obtained from gas—all of which looks very much as though the clever men managing the affairs of these large corporations can see clearly that the time has arrived when there is an extended field opening for the consumption of gas, and that they propose to be ready to occupy that field as soon as opportunity offers. Here is an example that our own companies might follow with profit.

The extension of the uses of gas beyond those of mere illumination, is not "worked up" as it might be. Every manager can see the benefit that would result; but the practical difficulty is to secure such action on the part of the company as would acquaint the public with the truth in the matter, and convince them of the real advantages to be derived from a more general use of gas. In England many corporations have endeavored to attain this end by means of exhibitions of the various appliances for the most economical use of gas for manufacturing and domestic purposes. South Shields, under the direction of Mr. Warner, the present President of the British Association of Gas Managers, has been very successful in this respect, also Birmingham, Huddersford, and many others, have increased their day consumption by the same means; and, now, Manchester is following in the wake, and, no doubt, will reap full returns in due time.

As Americans, we are not usually deficient in "push"; but, in this matter, our English cousins have certainly taken the lead of us. It is time that we did something in this matter, and, doubtless, we shall soon close up this gap; and, availing ourselves of their experience, be able to compare most favorably with our brethren across the water.

The next annual meeting of the American Gas-Light Association is to be held in Philadelphia, the city of all others where gas apparatus is made in the United States. There is a good place to begin. Why should not the Executive Committee of the Association take this matter in hand in season, and call upon all who have useful, or even ornamental appliances for the use of gas, to unite in making an exhibition where not only gas men, but the public in general may see for themselves what may be done with gas.

The Exhibition, although held at the same time as the Meeting, may be kept entirely distinct and separate from it. There is no doubt that if due notice is given, there would be contributions to the Exhibition from abroad as well as from our own country. It would require care in arrangement and classification, but beyond that but little labor or expense would be incurred; and in no way could the Association spend money better than in paying the rent for the necessary room to carry out this idea. This being done, the matter of arranging smaller local exhibits would naturally follow. Active work pays in any business; and if one-half the enterprise had been shown in getting up and securing the proper use of *good* gas burners and stoves that has been exhibited in producing good burners for kerosene oil, the gas business would have suffered less from its competition.

We hope the gas engineers throughout the country will take this matter in hand; and that, at Philadelphia next October, we may have as complete and extensive an exhibit of appliances for gas consumption as has been held anywhere.

[From the "Gas Trade Circular and Review."]

Gas Miscellanea.

"The Southern District Association of Gas Engineers and Managers" held their Annual General Meeting at the Bedford Hotel, Southampton Row, London, on the 14th ult.

The President, Mr. Eldridge, gave a short address, and the formal business of electing officers for the ensuing year was gone into, viz.:

President—West, John, Maidstone.
Treasurer—Wood, Alfred H., Hastings.

Committee:

Brett, R. W, Hastings. Farrand, C., Croydon.
Hunter, John, Woolwich. Cooper, W. R., Banbury.
Wadeson, Jas., Windsor.

Honorary Secretary, Chapman, J. L., Harrow-on-the-Hill.

The Secretary informed the meeting that Mr. Werdermann had kindly consented to give an especial exhibit of his system of electric lighting, if the members after the adjournment would make their way to the British Telegraph Works, Euston Road.

An able discussion was carried on by the President, Messrs. Livesey, Wood, Woodall, Morton, Wilson, and others as to the present state of the electric light and the effect it is likely to have on gas companies.

Mr. Werdermann explained his system, and showed the current divided and supplied to two large lights, and afterwards to ten lights of lesser illuminating power, the members all availed themselves of the opportunity to view the process, and were much interested.

At six o'clock dinner was served at the Bedford Hotel, about five and twenty members being present. The usual loyal toasts were proposed and drunk with customary enthusiasm. The next being success "to the Southern District Association of Gas Engineers and Managers," followed by "Prosperity to the British Association of Gas Managers," by the President, who said that, instead of district associations weakening the parent tree, he considered that they were a great means of strength, and might be looked upon as schools to educate managers to take part in the proceedings at the annual gatherings, and give them confidence to prepare papers. The name of Mr. Corbet Woodall, the late president, was coupled with the toast. Several other toasts were proposed, amongst them the health of the "Visitors," which was well acknowledged by Messrs. F. W. Hartley and W. H. Bennett. Altogether a most enjoyable evening was spent.

An ordinary meeting of the Midland Association of Gas Managers was held at the Midland Hotel, Birmingham, on Thursday the 24th ultimo, under the presidency of Mr. Chas Hunt, and was very numerously attended.

At the conclusion the election of office-bearers for the ensuing year was proceeded with—

Mr. Charles Hunt was re-elected President.
Mr. P. Simpson, was re-elected Treasurer.
Mr. J. Tindall was re-elected Honorary Secretary.

Messrs. C. E. Jones and G. E. Stevenson were elected members of the Committee, in place of those retiring, and Messrs Storer and Cross auditors.

The usual votes of thanks terminated the proceedings.

Reduction in Price of Gas at Hartford, Conn.—The price of gas furnished by the Hartford Gas-Light Company has been reduced from $2.75 to $2.50 per 1,000, from and after Dec. 1, 1878.

Artificial Light.—At the Royal Academy Professor Barff, M.A., delivered a lecture on light and what kind of artificial light is best adapted for studios, picture galleries, etc. Having briefly and lucidly explained the more important phenomena in connection with the transmission and refraction of light, illustrating his remarks by the aid of the spectroscope, Professor Barff said, with respect to the question which was absorbing so much attention at the present time (electric light), he was of opinion that very few of those who listened to him would live to see it in every house; and with all that had been said about banishing their old friend gas, if he had had a few thousand pounds to spare he would not have hesitated to invest it in gas shares. At all events, gas was now the general illuminating agent, and he wished to show what he considered to be the best burner which could be used (Silber burner), which the inventor had now brought to a state of perfection. By the use of this patent the exact amount of air was allowed to enter the burner which experience had shown had the effect of producing the brightest light by absorbing the carbon in excess. Professor Barff then took an Argand burner, and compared the effect produced by it with the light emitted by the Silber burner, clearly demonstrating the superiority of the latter. It was also very important to mention that the Silber burner reduced the amount of sulphuric acid and acetylene thrown off by gas to a minimum, and in their effects upon pictures, books, and furniture too much attention could not be given to this matter. To artists it was especially necessary that they should have an artificial light which would enable them to discriminate the various gradations of color, and the Silber burner was undoubtedly the best invented for the purpose. As this was the last lecture of the series, there was a large and appreciative audience.—*Gas Trade Circular and Review.*

It has been Proposed to illuminate harvest fields, etc., by the electric light, so that agricultural operations can be carried on if necessary after sunset.—*Les Mondes.*

LECTURE UPON THE ELECTRIC LIGHT.

DELIVERED OCT. 17, 1878, BEFORE THE AMERICAN GAS-LIGHT ASSOCIATION,

By Prof. HENRY MORTON, Ph.D.,

PRES. STEVENS INST., HOBOKEN, N. J.

[Continued from page 30.]

In 1871 M. Z. T. Gramme, a cabinet maker, of Paris, presented to the French Academy the description of a new form of magneto-electric machine, possessing several new and remarkable features. Its general structure can be well understood from the accompanying figure, which represents one of its simplest forms as constructed with permanent magnets, and to be driven simply by hand power.

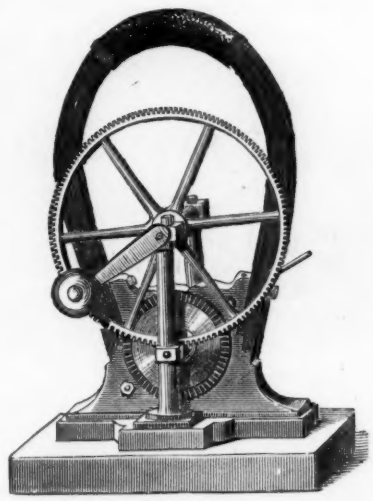

Fig. 28.

The large U magnets terminate in heavy end pieces, which constitute massive north and south poles, almost surrounding the armature, which constitutes the peculiar feature of this machine.

This armature consists of a ring made of a coil or hank of soft iron wire, around which are wound a series of coils of copper wire, in the the manner shown in Fig. 29, which represents such an armature partially dissected.

The ring made of a hank of iron wire is shown cut across and spread out to some extent, the cut ends appearing below B and at A. The several coils of wire are also represented partly in place above and spread apart in the lower part af the figure. The wire of these coils passes continuously from one to another, but between each makes a loop, which is hooked into a copper conductor, RR, constituting part of the commutator.

The general principle on which this machine acts can best be explained by reference to the diagram (Fig. 30). Let S and N represent the poles of the permanent magnet, and the divided ring between them stand for the ring of iron wire.

This ring, under the influence of the poles S and N, will always have a north pole at n and a south pole at s, the parts p and p_1 being neutral, or,

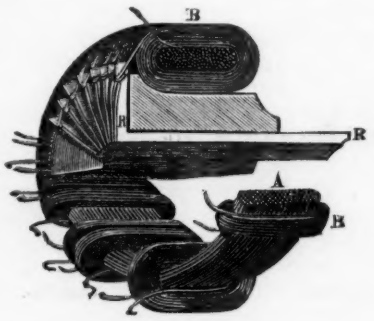

Fig. 29.

in other words, will correspond with two semi-annular magnets with their north poles together at n and their south poles together at s. The magnetic currents in the various parts of this ring will then be represented by the arrows drawn on it. As the ring rotates these poles will always maintain essentially the same position in space, and therefore, in relation to the coils wound on this ring, we might assume that this inner ring was at rest, and that the coils above were carried round over it.

Now let R indicate such a coil, and suppose it to move toward the right; it will evidently leave more magnetic currents in a given direction in the left hand semi-annulus than it approaches, and will therefore acquire a current in the direction shown by the arrow, to which will be added the effect due to approaching the opposite currents in the upper part of the

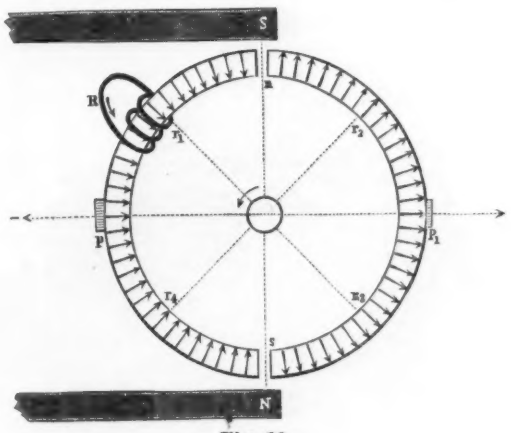

Fig. 30.

right hand semi-annulus. At n, and also at s, this action will reach a maximum, as the coil will be (at n, for example) approaching all currents of the right hand semi-annulus and leaving all those of the left, and vice versa at s. At p and at p_1, however, the effect will be nil, as the coil would there appoach and leave equal numbers of currents of like direction.

Now if we consider a number of coils all moving around from left to right, on the upper part of the ring the currents in them will have the same direction; and if they are all connected together these currents wi aid each other, and may be taken off by conductors pressing on the commutators at p and p_1. Let us suppose that the current is such as to mak p_1 positive and p negative. As the coils pass p_1 the direction o ithe currents in them is reversed, but so also is their relation to the conductor or commutator. Thus, a coil which was coming toward p_1 from above was sending its positive current forward toward p_1; as it leaves p_1, going onward below, its current being reversed, it no longer sends its positive current forward, but sends it back to p_1, which it has passed. Thus p_1 gets not only the positive current from the coils on the upper half of the ring, but from those also on the lower half.

By reason of the action which has thus been described, there is in the first place no rapid reversal of magnetism in the iron core of the armature, as in the Wilde machine, but only a continuous and progressive change as the ring rotates; and in the second place there is a continuous current of electricity in a constant direction, with only one reversal for each revolution of the entire set of coils.

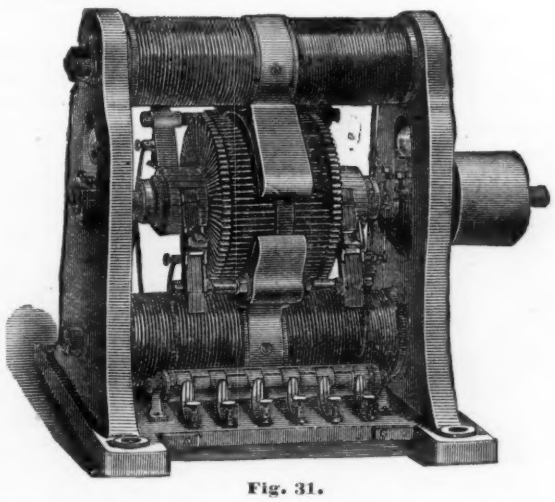

Fig. 31.

Of course the method of passing the current of one machine through the coils of an electro-magnet replacing the permanent magnets shown in Fig. 28, could be carried out with this machine just as with Wilde's; or the machine itself, being made with electro-magnets, these could be excited by its own current, as with the machines of Ladd and of Siemens, which we have already described. This last plan was, in fact, at once adopted, and the standard Gramme machine was made in the form shown in Fig. 31.

Here the electro magnets consist of the large horizontal cylinders seen above and below, so wound with wire as to produce a combined north pole at the centre above, where the extension piece is attached, and a corresponding south pole below.

Within and between these extension pieces is the armature or bobbin, consisting of the iron ring wound with its numerous flat coils. The connections in this case are carried out on both sides of the axis, and thus several pairs of brushes can be applied, and numerous currents taken off.

With all these machines, however, the best effects are obtained by employing only one circuit, or passing the whole current from the bobbin

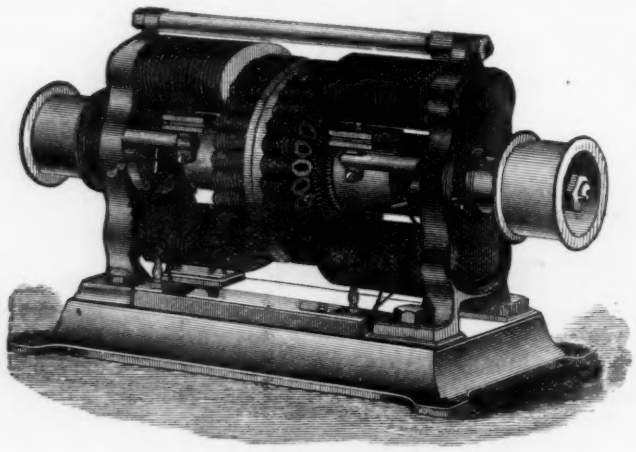

Fig. 32.

through the electro-magnet coils and the exterior circuit, where it is used.

In 1873 Wilde described a new form of magneto-electric machine, in which he abandoned the use of the Siemens armature, and returned, in general structure, very much to the form of the old Alliance machine.

Two sets of electro-magnets, 16 in each, were arranged in such a way that they formed two hollow cylinders opposite each other, with the poles of the magnets of each cylinder facing each other, but having space between for another cylinder of 16 electro-magnets, mounted parallel with the others, and carried by a disc of iron, from which they projected at each side. In fact, there were three cylinders of magnets, all having a common horizontal axis; the outer ones fixed and the inner ones radiating, so as to carry its magnets between the poles of the others.

Good effects were obtained with this machine, and the heating of the armatures was avoided, but it was not found to equal the improved Siemens or the Gramme in efficiency or economy of power.

In 1875 a patent was taken out in the United States by Mr. Moses G. Farmer for a machine essentially like that of Wilde, just described. This, with some modifications of details, is now manufactured by Wallace & Sons, of Ansonia, and has come into very general use.

In the experiments made by the present writer, as well as those conducted by the Franklin Institute, this machine seems to be inferior in "duty" to some others; but the conditions of such trials are so difficult to establish, in adapting the nature of the exterior circuit, including the lamp, to the

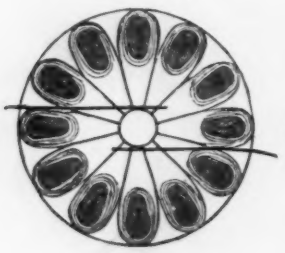

Fig. 33.

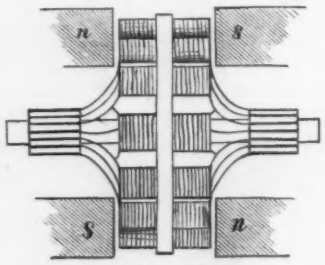

Fig. 34.

peculiarities of each machine, that I should not regard these conclusions as absolutely final.

In the Wallace-Farmer machine (Fig. 32) the magnetic field is produced by two horseshoe electro-magnets, but with poles of opposite character facing each other. Between the arms of the magnets, and passing through the uprights supporting them, is the shaft, carrying at its centre the rotating armature.

This consists of a disc of cast iron, near the periphery of which, and at right angles to either face, are iron cores, wound with insulated wire, thus constituting a double series of coils. These armature coils (Figs. 33 and 34) being connected end to end, the loops so formed are connected in the same manner, and to a commutator of the same construction as that of the Gramme. As the armature rotates, the cores pass between the opposed north and south poles of the field magnets, and the current generated depends on the change of polarity of the cores. It will be seen that this constitutes a double machine, each series of coils, with its commutator, being capable of use quite independently of the other; but in practice the electrical connections are so made that the currents generated in the two series of armature coils pass through the field-magnet coils, and are joined in one external circuit. This form of armature also presents considerable uncovered surface of iron to the cooling effect of the air, but its external form, in its fan-like action on the air, like that of the Brush, presents considerable resistance to rotation. In the Wallace-Farmer machine there was

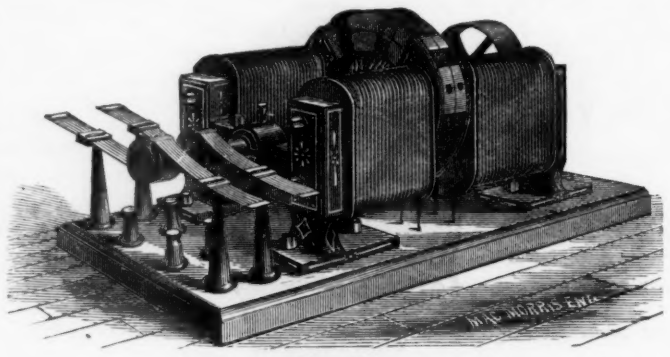

Fig. 35.

considerable heating of the armature, the temperature being sufficiently high to melt sealing-wax.

Another machine made and used in this country to a considerable extent is that of Mr. Brush, manufactured by the Telegraph Supply Co., Cleveland, O. This is shown in Fig. 35.

The Brush machine has for its magnetic field two horseshoe electro-magnets, with their like poles facing each other, at a suitable distance apart, the circular armature rotating between them.

In this machine the currents are generated in coils of copper wire wound upon an iron ring, constituting the armature. This ring is not entirely covered by the coils, as in the Gramme armature, but the alternate uncovered spaces between the coils is almost completely filled by iron extensions from the ring, thus exposing large surfaces of the armature ring for the dissipation of heat, due to its constantly changing magnetism, as in the Pacinotti machine.

The ring revolves between the poles of two large field magnets, the two positive poles of which are at the same extremity of the diameter of the armature, and the two negative poles at the opposite extremity, each pair constituting practically extended poles of opposite character.

The coils on the armature ring are eight in number, opposite ones being connected end to end, and the terminals carried out to the commutator. Figs. 36 and 37 show this arrangement, only one pair of coils, however,

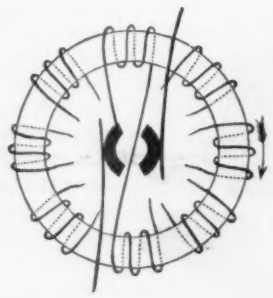

Fig. 36.

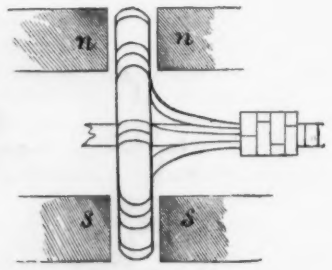

Fig. 37.

being shown in Fig. 36 as connected. In order to place the commutator in a convenient position, the terminal wires are carried through the centre of the shaft to a point outside the bearings.

The commutators are so arranged that at any instant three pairs of coils are interposed in the circuit of the machine, working, as it were, in multiple arc, the remaining pair being cut out at the neutral point; while in the Gramme machine, the numerous armature coils being connected end to end throughout, and connections being made to the metal strips composing the commutator, two sets of coils in multiple arc are at one time inter-

posed in the circuit, each set constituting one-half of the coils on the armature.

The commutator consists of segments of brass, secured to a ring of non-conducting material, carried on the shaft. These segments are divided into two thicknesses, the inner being permanently secured to the non-conducting material, and the outer ones, which take all the wear, are fastened to the inner in such a manner that that they can be easily removed when required.

The commutator brushes, which are composed of strips of hard brass, joined together at their outer ends, are inexpensive and easily renewed. The high speed at which these machines are run, together with the form of the armature, cause the rotation of the latter to be considerably resisted by the air, and producing a humming sound, but otherwise they run smoothly, the heating of the armature being inconsiderable—not exceeding 120° Fahr. after four and three-quarter hours run.

When the Jablochkoff candle came into vogue it became highly important to go back in one of the directions in which improvement had been made in most of the recent machines, and produce a machine which should yield alternating or reversing currents, in place of those passing continuously in one direction. This was necessary to equalize the consumption of the two parallel carbons of the Jablochkoff, and also even with other lamps, for purposes which we will explain further on.

To meet this requirement Gramme has arranged a machine which not only produces alternating currents, but operates readily, at the same time, a number of separate circuits. It is these machines which were recently

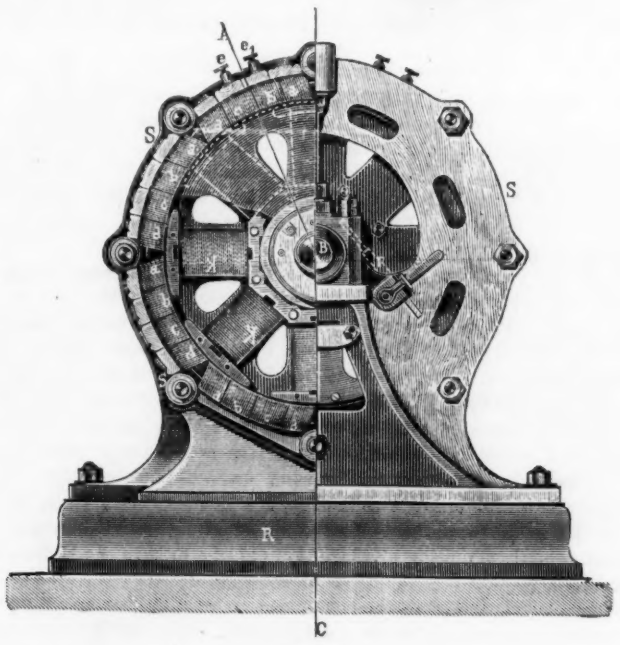

Fig. 38.

used during the Exposition to light certain streets and public places in Paris. The general appearance of this machine is shown in Fig. 38.

This machine, it will be observed, differs radically from the continuous current machine of Gramme.

In the first place, it is, as it were, turned inside out. Thus there is a magnetic ring wound with successive coils, but this, in place of revolving within the field of fixed electro-magnets, is stationary on the outside, while a series of eight electro-magnets, excited by a separate machine, rotate in the interior of this fixed armature ring.

The principle of the machine will be readily understood from the diagram (Fig. 39).

The interior system of electro-magnets is so wound that the polarity of each spoke is reverse to its neighbors. These magnets, therefore, by induction develop eight consecutive poles in the soft iron of the surrounding ring, and as they revolve the poles of this ring move with them. Thus, while in the older Gramme machine the actually moving ring had poles stationary in space, over which the coils passed, in this case the actually stationary ring has moving poles which pass through the stationary coils.

These coils are wound in eight sets, each alternate set being wound in an opposite direction, and each set is made up of several separate coils, to facilitate the making of all sorts of combinations, which are most easily arranged in this machine, as no commutators are used, and all the coils are fixed.

If all the coils marked *a* are connected together, it is evident that at any moment the currents in all of them will be in the same direction. Thus, suppose the electro-magnet spoke 2 to have a north pole at its outer end, and 3 to have a south pole similarly situated; then as 2 moves over *a* it will produce a current alike in direction to that produced by the opposite pole of 3 moving over the oppositeiy wound wire of the next coil marked *a*.

Of course, as the magnet 2 leaves *a* and the oppositely polarized magnet 1 approaches, this current will be reversed in the first coil marked *a*, and also likewise in the second coil *a*, for a like reason.

It has been stated that these machines worked one Jablochkoff candle for each horse power consumed, but several who watched their actual running say that very much more power was actually consumed.

THE LONTIN MACHINES.

Among the machines for generating electricity that have commanded more or less of general attention, may be included the magneto and dynamo-electric machines devised by Lontin. In their mode of construction and arrangement these machines possess features which recall the Alliance and Holmes magneto machines on the one hand, and the Siemens and Gramme dynamo machines on the other.

There are two styles of Lontin dynamo machines, the one yielding continuous currents of one direction, and the other producing alternating currents.

In the machine of the first form, a number of bar electro-magnets are disposed radially about a central shaft of soft iron, and the star-shaped wheel thus formed is made to revolve between the poles of an ordinary powerful U-shaped electro-magnet. The wire of the electro-magnet wheel

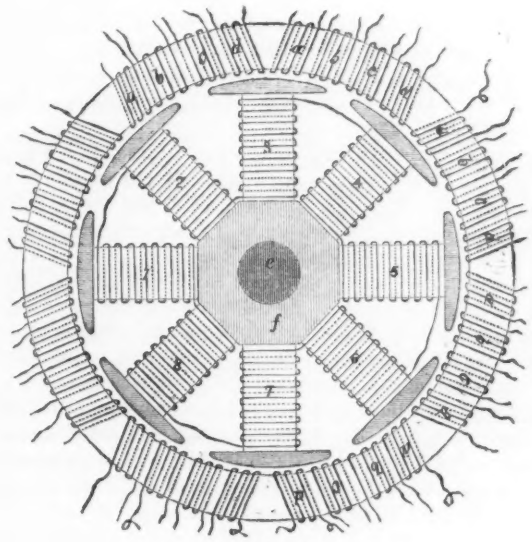

Fig. 39.

forms one complete circuit, and is connected at the several point of juncture of each two successive magnet coils, with the appropriate section of a commutator, placed upon the axis of the machine. On revolving the wheel between the poles of the stationary upright field magnet it will readily be seen that, considering any individual radial electro-magnet, there will be induced in the coil of the latter, during its motion away from one pole and its consequent approach to the opposite pole, a current which, though varying (first diminishing and then increasing) in intensity, will still maintain a constant direction until the coil has arrived at the opposite pole, where a reversal of the current will take place. The current will continue flowing in this new direction until the revolution of the wheel brings the coil back to the pole from which we have considered it to start, when and where the current will be restored to its former direction. At any moment, therefore, during the revolution of the wheel, all the electro-magnet coils in the upper half of the wheel will be traversed by a current flowing in one direction, and all those in the lower half by one in the opposite direction. Elastic strips, one on each side, bear against the commutator in the line where the reversal takes place, and lead away the currents to the proper binding posts. The mode of generation and direction of the currents in this form of the Lontin machine is thus seen to be exactly similar to that obtaining in the Gramme machine.

The stationary electro-magnets are included in the main circuit, in accordance with the dynamo-electric principle. By mounting several of these wheels of electro-magnets, with separate commutators and field

magnets, on the same central shaft, an equal number of independent currents may be obtained, which by appropriate means may of course be combined in any desired manner.

By winding the alternate electro-magnets on each wheel in opposite directions, the machine may be made to produce currents constantly varying in direction. The Lontin machine proper, for alternating currents, has, however, a more elaborate form, bearing a rather close resemblance to the machine devised by Holmes.

This Lontin machine consists essentially of an electro-magnet wheel, like that in the first described form of the machine, only that the magnets are much more numerous, amounting in number to 24 and over, and are wound in the manner just referred to—that is, the alternate magnets are wound in opposite directions; and of a large stationary soft iron ring surrounding this wheel concentrically, to which ring there are secured, at equal distances apart, a number of short electro-magnets, equal in point of number to the electro-magnets on the inner wheel. The electro-magnet coils of the revolving wheel are connected together, so as to form one circuit. The current necessary for the saturation of these magnets is obtained from an auxiliary machine (a Lontin machine of the first form, for instance), mounted upon the same axis, connections being so made, by means of brushes and collars, that the rotation of the large wheel does not interfere with the circulation of this current. The ends of the electro-magnets, during the rotation, pass very closely by the cores of the outer stationary magnets, and as the successive magnets on the wheel present opposite poles to these cores, constantly alternating currents are induced in these outer magnets. One series of terminals of the coils of these magnets is led to one binding post, while the other passes to a set of circuit-closing devices, by means of which all of the currents, separately or together, or any individual one or ones, may be conducted away from the machine.

The great merit of this second form of the Lontin machine lies in the facility with which currents varying in number and intensity may be derived from it, so that quite a number of electric lights may be produced at the same time, and also in the fact that in the conducting away of these currents contact brushes are entirely dispensed with; so that the great loss in electricity attendant upon this mode of collection, besides the frequent attention required by its use, are entirely avoided.

With a velocity of rotation of 320 turns per minute, the machine being arranged so as to yield 12 separate currents, the outer magnets being connected together two and two for this purpose, 12 lights were obtained, each equivalent to 740 candles. Three series of 8 magnets each gave 3 lights, each having an intensity of 1,480 standard candles.

It is said that to prevent any detriment to the machine arising from the conversion into heat of any currents that may not be required, while the remaining ones are being applied to some special purpose, these superfluous currents are made to pass through appropriate resistance coils, and thus become in a manner absorbed.

A large Lontin machine of the kind last described was used at one time for lighting the railway depot at Lyons, where it fed 31 separate lamps, each giving out a light of about 340 candles. The power needed to run this machine is not stated. Another machine of this form, giving 24 lights of 1,480 candles, required from 20 to 22 horse power to drive it. Smaller machines, of from 2,000 to 3,000 candles, demand somewhat more than 5-horse power.

SIEMENS' NEW MACHINE.

Siemens and Halske have lately devised a new dynamo-electric machine, for the production of one or several independent currents, which may be made at pleasure either intermittently unidirectional or rapidly alternating in character.

In one form of this machine the two sides of an upright iron frame carry each a series of 8 circularly disposed electro-magnets, the cores of which stand out at right angles to the sides, and carry at their ends, where they face the corresponding cores of the opposite series, large flat plates of soft iron. The plates of each set are alternately of opposite polarity, while those facing each other exhibit the same polarity; and as the space between them is made as small as the mode of construction will permit, magnetic fields of high intensity and of alternately opposite polarity will come to be formed.

Upon a shaft running through the centre of the frame there is secured a disc, carrying on its circumference an upright iron ring, oblong in section, made either of wire or plates, sometimes also of massive iron. This ring is surrounded at eight (or more, in some forms of the machine) equidistant places by flat coils of insulated copper wire, which, with the ring, are carried by the rotation of the shaft through the magnetic fields formed by the electro-magnets. Two of the coils on the rotating ring are devoted exclusively to the purpose of keeping the field magnets saturated, in accordance with the well-known dynamo-electric principle; and since the current in this case must be constant in direction, a special commutator is provided to secure this result. The alternating currents obtained from the remaining coils are conducted away from the machine by means of collars and brushes in the ordinary manner.

The great resemblance of this machine to a machine of the Brush form, in which eight sets of electro-magnets are employed, instead of the usual two, need scarcely be pointed out.

Several forms of the machine above described are manufactured by Siemens and Halske, the details varying with the purposes to which it is intended to apply any particular machine. The larger machines possess one important distinctive feature, in that no iron is made use of in the construction of the revolving disc, the cores of the coils being formed of wood, or some other non-magnetic material. By this mode of arrangement the hurtful inductive effects, the production of Foucault currents, the loss of power by conversion into heat, and the like, attendant upon the use of iron in this connection, come to be entirely avoided.

[To be continued.]

GAS LIGHTING *v.* ELECTRIC LIGHTING.

By Thomas Nesham Kirkham, M.I.C.E., & F.C.S., and Thomas Hersey,
late of the Imperial Gas-Light Company, London.

The gas scare continues, and is likely to do so, while day after day the newspapers insert fresh pieces of news as to the progress of electric lighting, each new thing, if only true and practicable, sufficient to considerably injure the gas companies.

As, however, there is not at present much real data as to the cost and value of the electric light from experiments in England open to the public we, as experienced gas engineers, have investigated for ourselves the data furnished by M. Hippolyte Fontaine as to the results of using the electric light in France, and we have personally examined the Jablochkoff system as shown at Messrs. Wells & Co. in Shoreditch, that of Mr. Werdermann in the Euston Road, the Rapieff system at the "Times" office, and the Lontin light at the "Gaiety" Theatre.

But, before going into the cost and value of the electric light, we, as having a considerable knowledge of the management of the Metropolitan Gas Companies, desire to say that we are utterly at a loss to understand the reason for the cry raised against them by the newspapers, which, almost without exception, appear to have a grievance, and to represent that the public in general have great cause for complaint; and as we know this to be without adequate foundation, we think it right to say so, and to point out that it is almost impossible for any producers of an article for sale to be more stringently kept from going wrong—even if they desired to do so—than are the Metropolitan Gas Companies, and especially those of them that are under the more recent legislation, which represent share and share and loan capital amounting to £9,570,571 out of a total in the Metropolis of £11,845,749.

The new legislation binds the companies under it to give an illuminating power of 16 candles, and that they do give this, and more, is proved by the official testing of the Metropolitan Board of Works and the Corporation of London, who would be ready enough to enforce the penalties if there had been default, as has been proved by the enforcement on two or three occasions of the severe penalties for slight excesses in the sulphur impurity which the companies are compelled to keep as low as the Referees appointed by the Board of Trade can reasonably call upon them to do.

As regards pressure, the Act of Parliament has prescribed a minimum, but it is very seldom that it is even approached, so desirous are the companies that a full supply of gas should be afforded to all their customers; but with the enormous business of the companies there must necessarily arise defects from time to time, and all they can do is to have a sufficient staff of inspectors and workmen ready to remedy them without unnecessary delay. It should, however, be understood that much the larger number of complaints arise from the defects in fittings or burners belonging to the consumers for which the companies are not in any way responsible.

As regards the meters, the companies supply them at a rental to almost all their customers, although they are not compelled to do so except as to the smaller sizes of meters; but the consumers of gas can, if they please, purchase meters for themselves from any maker, and, so long as they are good enough to obtain the official stamp for correctness of registration, the companies must allow them to be used. "Correctness," however, means that meters may be stamped as correct if they register three per cent. against the companies, but they are not allowed to pass if they register more than two per cent. against the consumer. So even in this the consumer is favored at the expense of the companies.

We are quite at a loss to understand what the sins of the companies are,

except that Parliament, after lengthened enquiry, thought fit to grant them a regulated monopoly, which has been found to be beneficial both to the companies and the public, as, while the former have experienced a rapid decrease of price with a great improvement in the quality of the gas; the disturbance of the streets has been reduced to a minimum, and the wasteful outlay of capital avoided.

It should, however, be remembered, that although the companies pay their prescribed dividends, varying from four to ten per cent., very large portions of the capital have changed hands at high prices, so that recently the owners have been content with less than five per cent. seeing that the property appeared to be fairly safe; unfortunately, they have now been rudely awakened by a loss of nearly one-third of what was lately the market value of their property.

We are of opinion that this fall in value is entirely due to the action of the Press in puffing the electric light, as it is quite clear that if there were really anything in it, those Russian and other gentlemen from the Continent have a much larger field for its use in their own countries than there is here, seeing that gas on the Continent is not only very poor but very dear, while in this country the reverse is the case; indeed, it may with truth be said that gas is one of the very few things that continues to improve in quality and to be reduced in price.

Having said a few words about gas, we proceed to say what we think of the electric light, more especially as regards its cost, as we think it almost unnecessary to say anything about its convenience, seeing that, as at present used, nothing could be more inconvenient, whether we regard the production of the current, the daily and hourly reccurring trouble of replacing the carbons, or the probability of being from time to time entirely without lights through the breaking down of the steam or gas engine, or some portion of the electric machinery.

It appears to be thought that electricity is to replace gas-lighting to a very great extent, and that the capital necessary will not be very large, which appears to us to be an erroneous idea, as we believe that a very large capital will be required if much business is to be done; but we do not believe that capitalists will be found to invest their money in it. It is true that not much land would be required for works or storage, but capital will be largely necessary for other purposes, and, to begin with, a very considerable sum to obtain Parliamentary powers.

Assuming that the electric light companies will be prepared to supply light from stations, as it cannot be supposed that private consumers would be willing to incur the expense for engines and machines, or provide engine rooms for themselves, then a very large number of stations would be required, as it appears to be certain that the radius of supply must be very limited, and it will be necessary to have these stations, if only the public lamps and large factories and places of that description be supplied.

We think that before the electric light is much used for private lighting, it should be thoroughly tested for the public lamps, of which there are about 50,000 in the Metropolis, which at the ordinary distance of 50 yards apart represent about 1,420 miles of road, and as it would be necessary in most cases to place a main on each side of the road to carry the cables about 2,500 miles of main would be required, which, at a low estimate, would cost (including the relaying of pavement) £880,000, and the service pipes to the lamps £25,000.

The inconvenience to the public of taking up and relaying the pavement would necessarily be very great and long continued.

The cost of the cable (if only one be used), 2,840 miles at 3s. 4d. per yard, would be £416,000; to this must be added for wires and fittings to the lamps, say 4s. each, $10,000.

If we assume that Mr. Werdermann's system of dividing the electric light is as yet that most likely to be adopted, as he appears to have succeeded in bringing down the light to a manageable size, and that the ten lights he produces do really give the light of 40 standard candles each, then each of these would be equal to nearly three public lamp-burners, and ten of them would supersede thirty gas lamps, if Mr. Werdermann can without loss of light convey the current the 1,500 yards the thirty lamps cover; supposing him to be able to do so, and that the limit be 1,500 yards, about 1,700 stations would be necessary, and they may be estimated to cost, at a very moderate estimate, not less than £100 each for land and buildings, or £170,000.

Then, according to M. Fontaine (page 155) and Mr. Werdermann, to produce the ten small lights a 2-horse engine is necessary. (M. Fontaine, page 156, states, however, that 75 per cent. more than the ordinary working power is required to put the machines in action.) Assuming that they are right, and that gas engines as recommended be used, the cost of the 1,700 as per Crossley's list, would be £234,000. It is difficult to say exactly what the Gramme machines cost (see Fontaine, page 162), but we have estimated each station to cost £100 for machines and gearing, say £170,000; these items, without any allowances for contingencies, amount to £1,906,260, namely:

Mains	£880,000
Service pipes	8,333
Cable	416,660
Wires and fittings	10,000
Stations	170,000
Engines	234,600
Machines	170,000
Estimated capital for 16,666 lamps	£1,889,593

Estimated annual charge for 16,666 lamps:—

Interest on above capital at 10 per cent	£188,959
Maintenance and contingencies on engines and machinery at 8 per cent	66,500
Maintenance of engine stations, mains, service pipes, etc., at two per cent	21,500
Cost of gas for fuel, estimated at 21 feet per horse power per hour for 1,700 two-horse engines at 4,000 hours per annum	47,600
1,700 engine drivers at 5 shillings per day	155,125
200 men at 25 shillings per week for replacing carbons daily, cleaning lanterns, etc	13,000
Painting and maintenance of lamp columns and lanterns 16,666 lamps at 3s. each per annum, as paid by gas companies	2,500
Carbons for 16,666 electric lamps in lieu of 50,000 gas lamps, at 1d. per hour, 4,000 hours per annum	277,766
	£772,950

To this annual charge of £772,950 should be added rates and taxes, oil for engines, etc., etc.; but as the amount is already nearly four times that paid for lighting the public lamps by gas, viz.—

50,000 lamps at 20,000 feet per annum, at 3s. 4d. per 1,000 feet	£158,333
Lighting, cleaning, and maintaining, 18s. each	45,000
	£203,333

it may be safely left where it is.

If our estimate of the cost of electric lighting be even approximately correct, we think that there is no probability of it being largely used for the public lights, as, whatever its merits may be, there is not the slightest chance of the local authorities, who control the public lighting, putting it in use. Recent experience shows in the adoption by some parishes of the average meter system, that if by shortening the hours during which the lamps are burning, and by reducing the size of the burners, they can effect a saving of a few hundred pounds a year, they think they have achieved a great success, and having done this by the outlay of a considerable sum for meters, etc., they are not at all likely to increase the cost of lighting the streets, which they doubtless consider are now sufficiently lighted, even if they could get 100 per cent. more light for 20 per cent. more money, much less if they are asked to pay 160 per cent. more, as was the case in Paris, even with the high price of gas there, namely, 6s. 9d. per 1,000 feet as compared with from 3s. to 3s. 6d. in London.

Having, as we think, shown good reasons why the electric lights are not likely to supersede gas for the public lights, we proceed to suggest some objections to it for private lighting, although we think it scarcely necessary to do so, as the promoters of the electric light companies almost admit they do not anticipate any demand for it for ordinary shop or house lighting. M. Hippolyte Fontaine says (page 144 of Dr. Higg's translation), "That without being absolutely impossible, it is difficult to introduce the electric light where ceilings are of less height than 13 feet;" and again, page 104, "that manufacturers who pay only seven shillings per 1,000 feet for their gas, and find their establishment sufficiently lighted with twenty burners, should not seek a more economical light, unless they work all night without interruption." These two extracts sufficiently show that even in the views of the advocates of electric lighting a very large proportion of the consumers of gas are unlikely to be benefited by electric lighting, seeing how comparatively few are the rooms and shops 13 feet high, and seeing that manufacturers and others in this country can obtain at least forty burners for the cost of twenty in France. Thus the widest field is still left for gas companies even if electricity relieves them of a few open spaces, railway stations and manufactories.

M. Gramme advises, page 161, "that the machines be used only where there are large spaces to be lighted, and where there is sufficient power to prevent the addition of one or two machines interfering with the regular

process of the work ; 90 per cent. of the places in France where this light is used are on that data." This shows clearly that even in France it will not pay to provide separate engine power for electric lighting, and therefore leaves the great bulk of the lighting to be done by gas. Assuming, however, that it will not be necessary to limit electric lighting to railway stations, large manufactories, and such like buildings, and that it may altogether supersede gas, we again come to the question of cost, and it would appear that even if the engine houses and mains supposed to be provided for lighting the public lamps should be sufficient also to contain engines and cables for private lights, the further capital needed to supply about 240,000 consumers, now using about 2,900,000 burners, would be about £17,839,000.

Then, assuming that the engine-houses for public lamps would do also for the private lights, that the engine drivers would also be able to do all the work for public and private lighting, and that the cables for 2,900,000 burners would not cost more than the estimated £416,000 for the 16,666 electric public lamps, we arrive at the following estimate, viz.—

240,000 service pipes at 10 shillings	£120,000
Cable	416,660
Wires and fittings at four shillings	48,000
Assuming that 40 ordinary private lights would be equal to 10 Werdermann small lights, 72,500 two-horse gas engines at £138 would be required	10,005,000
72,500 Gramme machines and gearing	7,250,000
	£17,839,660
Annual charge upon the foregoing:—	
Interest at 10 per cent	£1,783,966
Maintenance and contigencies on engines and electric machinery, at 8 per cent	1,417,572
Consumption of gas, for fuel, say 4 hours per day, 21 ft. per horse power, 4,752,300,000 feet at 3s. 4d. per 1,000 feet	792,050
Assuming that each of the Werdermann small lights would be equal to four ordinary house burners 725,000 electric lights would be required to replace the 2,900,000 gas-lights, and the carbons burning four hours per day at one penny per hour per light, as stated by Mr. Werdermann, would cost £12,083 per day, or per annum.	4,414,295
Total	£8,407,833

These few items make up a total of £8,407,833, while the total rental for gas lights in 1877 for the whole of London was only £2,663,917.

It may be said that the cost for power would be very much reduced by using steam engines of large size, but this would be counterbalanced by the much larger engine and boiler houses that would be required, and by the necessity there would be of always keeping steam ready for use, and, therefore at large expense, which would be avoided by the use of gas engines, seeing that they are always ready for use at a moment's notice.

It may also be said that the cost for power might be reduced by the use of larger gas engines, which is true, as an eight-horse engine would not cost twice as much as a two-horse engine, but in many cases this would involve the use of much more than the actual power required ; so that, upon the whole, the advantage would be in favor of a large number of small engines, rather than a smaller number of large ones, especially as with small engines it would be easy to keep a spare one, to use in the event of accident.

If, however, the larger-sized gas-engines be preferred, the outlay of capital for the private lights would be reduced to £12,474,600, which would still be very much in excess of the capital invested in gas.

It might be possible to obtain carbons—nearly 800,000 a day—but the manipulation of them would not be an easy matter, and it would probably be necessary for the electric light companies, should they ever be in existence, to maintain and charge for a staff of men to go round daily to adjust the carbons, wires, etc., which, of course, would add materially to the cost of the system, and would certainly be much less convenient than the existing state of things.

We know, and all consumers, know the exact cost of gas, but it is probable that we have, from imperfect acquaintance with the electric light, omitted many items on the cost of it. We think, however, we have shown clearly that the probable cost of electric lighting is enormous, and that there is not the slightest chance of profit from it as a light for general purposes, if people could be induced to use it, which we very much doubt, even if it could be supplied from large stations like gas, and with as little trouble to the consumer, as it would involve in all cases alteration or substitution of fittings at considerable cost, and it is difficult to believe that, after the novelty has worn off, any persons would say it is a pleasant light, as compared with gas, or other mode of lighting, for domestic purposes now in use.

As regards the amount of illuminating power from the electric lights, we observe that in almost all cases the light of 1,000 candles and upwards is claimed, whereas Mr. Schoolbred, at the Society of Arts, showed from the careful experiments made by the engineers of the lighting department of the city of Paris, that the maximum illuminating power of the naked Jablochkoff light was equal to only 300 candles, which was reduced to 180 by the opaque globe, and that it varied between 180 and 90 candles, proving not only the deficiency in illuminating power, but what every one must have observed, the great want of steadiness in the light, which certainly would not be tolerated with gas lights. This unsteadiness is not confined to the Jablochkoff candle, as it is very noticeable in the Rapieff lights at the "Times" Office, where, besides the inherent irregularity, we noticed that during about twenty minutes, when we had the opportunity of witnessing the lights in the machine room, three of the six lights that were in use were from some cause out of order, and had to be readjusted, and one of the lamps to be exchanged, and this, although they were under the care of M. Rapieff himself and his practised assistants. What, then, would this light be in ordinary use ?

We did not observe so much irregularity in the Werdermann lights in the Euston Road, as during our inspection only one of the large lights required attention, but the illuminating power did not appear to us to be of anything like the amount stated, as when all the ten small lights were in use, which were said to be equal to 40 candles each, the lighting or extinguishing of two gas-burners made a very material difference in the lighting of the place.

We have looked into this matter carefully, and are fully convinced that, until very great improvements be made, the electric light will have no chance in competition with gas for ordinary purposes, even if the cost were no greater than that of gas ; but seeing that the electric light is enormously expensive, that all existing arrangements in our houses must be upset before it can be used, that the streets must again be pulled to pieces for the pipes to be laid, and again from time to time for repairs and alterations, we have no hesitation in saying that the proprietors of gas shares need not, in our opinion, be alarmed either for their dividends for their capital at present prices. We belive that there was not sufficient reason for the fall ; and the more we examine the question, the more we are assured that gas is not to be superseded at present before the world.

Dr. Redwood on the Electric Light.

The first of two lectures on the electric light was delivered on Wendesday night in the theatre of the Pharmaceutical Society, Bloomsbury Square.

Dr. Redwood began by stating that thirty years ago he had lectured in that institution on "Electricity as a Source of Light." The subject was then occupying public attention in very much the same way as it is now.

He had there one of Saxton's machines, which had been in his possession more than thirty years, and though little more than a toy in comparison with those now produced, it was yet capable of producing an electric light on a small scale without the expenditure of any other force than that which was required for mechanically rotating the armature of a magnet in front of the poles of a magnet. Thirty years ago, in discussing the subject of electric lighting, we were speculating as to the practicability of improving galvanic batteries for the cheaper production of electricity, but nothing had since been done in that direction. Yet many were then, as now, enthusiastic on the subject. Patents were taken out and companies formed for introducing the electric light as a substitute for gas light. What, then, had been done during the past thirty years, and how was it that the use of electric light was again being discussed as if it were a new subject? With reference to the first part of the question, it might be said that after many trials of many forms of apparatus, some of which were identified with some of those now again patented, it was found impracticable to accomplish what was required. None of the proposed forms of apparatus could be relied on for supplying constant light without continued personal attention, and no method was known by which the current could be broken up so as to be distributed to an indefinite and varying number of lights. The latter part of the question had two phases—one relating to the feasibility of employing electricity developed by galvanic batteries, the other relating to that produced by mechanical action. With regard to the first point, the question had been answered negatively 30 years ago, and with regard to the second the question still remained to be answered. What new laws had been discovered to render that practicable now which was pronounced impracticable 30 years ago. He was not aware of any such discovery having been made. He hoped we should not be tempted to exhaust our coal fields in an unprofitable contention between gas and electricity, or a useless attempt to violate the laws of nature by turning night into day. He thought that both systems of lighting would find their appropriate applications, the one supplying, as at present, sufficient light for ordinary purposes, and the other affording a more intense light for special applications.—*Iron.*

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MONDAY, FEBRUARY 3, 1879.

[From London "Journal of Gas Lighting."

West of Scotland Gas Managers' Association.

[CONTINUED FROM PAGE 34]

PAPER BY MR. YOUNG, OF CLIFFENS.

My next and last note has reference to what may be called condensation or precipitation by impact.

You are all aware that when we have a sudden change from moist warm weather to cold or frosty weather, there is produced by the sudden condensation of the water vapors in the air a dense fog or mist, which is so finely divided that it will continue floating in the air for days. You will also have observed that, in walking through such a mist the whiskers, so to speak, filter out and entangle those fine particles of moisture, and that hedgerows act in the same way, and keep dripping from the coalescence of the filtered-out particles.

Now, crude oil gases, when suddenly cooled, present the same conditions as the moist air. The tarry particles and aqueous vapors condense, but in such a finely-divided state as to keep floating with the current of gases. This condition of the condensed matter in the crude gases makes it difficult to get them separated, and many plans have been adopted to get quit of them. We have the old breeze-box, in which the particles were filtered out; we have the dry scrubbers filled with coke or brushwood, where the particles are filtered out or entangled, as the fog was filtered from the air by the hedgerows; and lately we have had before us Mr. Aitken's mode of filtering through wire gauze.

I am now desirous of calling your attention to a mode of separting those particles of condensed matter from the gas. I have here a still containing a little tar and coal, and heated up to the distilling point by passing through it a current of air or coal gas until it becomes saturated with the vapor, and by cooling it by passing it through this tube the vapor is condensed in the minute state of division I have referred to. The stream of gas containing the finely divided tarry particles issuing from the pipette is made visible as a jet by the presence of the condensed vapors. Now I may cause that jet to bubble through a considerable depth of water without the tarry matter being separated, and you see they float through the ball. I have here this white plate of porcelain, against which I will now direct the jet of mixed gas and tarry particles. You observe that the tarry particles are at once precipitated, and the gas leaves the plate quite invisible, all the tarry matter being removed. You see how I can go on forming figures with the jet by shifting it about over the plate, the tar being left behind as a black band. Now I wish you to observe that this result is brought about only when the stream or jet is brought within a very short distance of the plate. When I draw the jet a little father back, the precipitation is altogether arrested.

I shall again repeat the experiment, employing this sheet of glass, which will perhaps enable you to better observe the results. This time I will gradually bring the jet forward to the plate. You will observe that at this distance no precipitation takes place, but gradually, as it approaches closer, the precipitation of the tarry particles becomes more and more perfect, till they are entirely precipitated, and the gas leaves the plate invisible.

So far as I know, there has not hitherto been any scientific explanation published of how those results are brought about. I have given the matter some little thought, and have hit upon what appears to me to be at least a feasible explanation. Whether I am right or wrong in this explanation I shall leave you to decide.

Suppose I take an india-rubber ball and throw it against a plate; of course it rebounds; but if I take a ball of glazier's putty or of plastic clay, it does not rebound, but either sticks fast to the plate or falls to the ground. Now why does the rubber ball rebound and why, on the contrary, does the clay stick to the plate? Simply, as you are aware, because the rubber ball is elastic, and the clay not so.

Now it occurred to me that the cause of the precipitation of the finely divided particles of tar and water from the gas is due to the difference in their elasticity; that when a stream of gaseous molecules and tarry particles is caused to impinge against a plate, the gaseous molecules, being elastic, rebound from the plate, like the rubber ball; whereas the tarry particles, being comparatively non-elastic, do not rebound, but stick to the plate like the plastic clay.

You will remember that when I made the experiment I pointed to the fact that it was only when the point of the pipette, from which the mixed gas and tarry particles issued, was brought close to the plate that the precipitation was complete, and that at greater distances the precipitation was not effected. I believe the explanation of those effects to be that, in order to get the minute particles of tar to come into actual contact with the plate, it is necessary that they should be driven forward at a considerable velocity, because each of the particles of tar is surrounded by an elastic jacket of molecules of the gas which cohere with considerable force; and it is only when the particles of tar are impinged against the plate with such velocity as to overcome this cohesive force of the molecules of air to the tarry particles, and, as it were, thrust them aside, that the tarry particles come into actual contact with the plate, and are precipitated. Where the velocity is not sufficient to accomplish this, the jacket of elastic air molecules causes the tarry particles to rebound. Further, when the jet is some distance from the plate, the issuing stream of gas and tarry particles entangles the surrounding gas, and in communicating motion to it is itself partly arrested, and, at the same time, the stream is so enlarged that it meets the molecules of gas recoiling from the plate, and thereby the particles of tar are made to rebound, the air molecules acting as an elastic skin.

MM. Pelouze and Audouin, of the Paris Gas Works, have invented a beautiful arrangement, founded upon the above principle of precipitation, for extracting the condensed finely-divided matter from the gas. As the arrangement has been widely advertised and illustrated, in all probability most of our members are conversant with it. I shall not, therefore, make further allusion to it than to say that, in my opinion, this instrument has not been taken advantage of to the extent it deserves.

Although this mode of precipitating the tar and other finely-divided condensed matter from the gas is a most beautiful one, there are dangers attending its use; for, if the crude gases are cooled to a low temperature before they are subjected to this precipitating process, there are not only precipitated the tarry and other particles which we wish removed, but also some of the vapors of the volatile hydrocarbons which it is desirable to leave in the gas. Indeed, I believe that this precipitation of the hydrocarbon vapors is one of the causes preventing, to a certain extent, the adoption of this most beautiful invention.

To prevent this injurious effect it is only necessary to subject the crude gases to the precipitating process while they are heated, or to cause the crude gases to impinge against a heated surface.

Now, to obtain the gases in a sufficiently heated state, it would be necessary that they should be heated before they enter the hydraulic main—that is, as the gases would require to be heated as they issue from the stand-pipe, the idea suggested itself to me that this could be advantageously accomplished by substituting the precipitating arrangement for the ordinary hydraulic seal. To produce an automatic seal on the stand-pipe, it is necessary that a certain amount of pressure should be expended in working it, and, by substituting this mode of seal, advantage is taken of the pressure to cause the precipitation of the tarry impurities. It has this further advantage, that it prevents pulsation of the gases inside the retort, with its attendant evils, and the valves being all alike in weight, the pressure inside the retorts can be regulated to be exactly the same. I first tried a modification of the arrangement of MM. Pelouze and Audouin to the stand-pipe; but I found this to be unmanageable, as the small orifices got closed with sooty tar which was present. However, by substituting a valve arrangement, and, instead of dividing the gas into minute streams, dividing it into sheets or films, and allowing these sheets or films to impinge against a plate, the same end was attained.

The arrangement may partake of a variety of forms, but in its simplest form it very much resembles the ordinary safety-valve for a steam boiler. I have here a diagram of two forms of arrangement, which are shown as being suitable for attaching to the ordinary stand-pipe in use. The one, you will observe, consists of a mushroom-shaped valve, formed of thin metal, similar to a Morton's self-sealing lid. This valve rests on a turned face, and the valve orifice is surrounded with an annular piece of metal. The crude gases pass up the stand-pipe, and as the valve is more easily lifted than the water of the seal displaced, the crude gases issue in a fine stream or sheet all round the valve, and impinge against the annular plate of metal; the sooty tar particles are precipitated, and flow to the hydraulic, the gases passing, over the surface of the tar in the hydraulic, to the condensing arrangement, by a separate pipe, or to be treated by a succession of such valves, so that the condensed matter may be precipitated, and the gases left fully charged with the hydrocarbon vapors, which it is desirable should remain in them.

The other arrangement consists of a valve and slotted tube. The valve is lifted by the pressure of the crude gases from the retort, which find their way through the slots. Opposite the slots are ridges of metal, against which the issuing sheet of crude gases impinge, and where the tarry particles are precipitated.

A modification of the latter form of valve may be conveniently employed where it is desirable to treat the crude gases after having been cooled. It consists in making the ridges hollow, and introducing steam, which keeps the ridges so hot as to prevent the precipitation of the hydrocarbons from the gases along with the tars, and by employing a series of such precipitations a very perfect condensation of the gas may be effected.

As the opening and closing of the valve at each charge crushes out or scrapes away any tarry, sooty matter which may have collected in the valve orifice

or slots, the arrangement is thereby prevented from becoming choked up.

I think, gentlemen, that is a very rough outline of my thoughts on these subjects, which I have jotted down from time to time. As I have already explained, my principal object in bringing them before you to-day was—in so far, at least, as my efforts may avail—to foster among our members the taste for a higher technical education, and with the hope that this narration might induce some of the members, more particularly the younger and more energetic, to take up the subject and experiment for themselves.

Recently, in the pages of the *Journal of Gas-Lighting*, attention has been drawn to the desirability of a higer scientific education among us; and Mr. Nettleton, Secretary of the American Association of Gas Managers, has lately pointed out, in a circular to its members, that it is only by the closest investigation into the natural laws which affect the manufacture of gas—such as chemistry, physics, and applied mechanics—that we shall be able to make such progress in gas manufacture as shall enable us effectually to compete with other forms of lighting.

There can be no question that we shall have a powerful rival in electricity. I have not the least doubt that there is a great future for electric lighting. At present there is no likelihood of its being introduced for domestic purposes, but I can fully believe that the day is not far distant when such improvements shall have been made in the lamp (for there the defect lies) as will enable electricity to be employed for lighting workshops and large open spaces.

The more quickly, therefore, we put ourselves in fighting position the better; and this, in my opinion, can be done only by bringing to bear upon the subject more energy and a higher scientific training.

Gentlemen, I have to thank you for the kind attention which you have given to these remarks.

The Chairman—We are indebted to Mr. Young for his interesting paper, which touches on a great variety of subjects, every one of which is of very great importance to those engaged in the manufacture of gas. The deposit of carbon in retorts gives a great deal of annoyance, and besides is a source of considerable loss. You have heard of the mode of obviating this nuisance. Then we have had information as to the advantages of having a space above the coal in the retorts, and also as to the methods of taking the the gas off, as Mr. Young has just stated. If any member would like to have further explanations, I am sure Mr. Young will be glad to any questions.

After a pause, the Chairman continued:—If there are no questions to be asked, I would move that a hearty vote of thanks be accorded to Mr. Young for his interesting paper.

Mr. McLeod (Glasgow)—Would you, Mr. Chairman, allow me to make one suggestion? Within the past month or two a great deal has been said about the higher education of the gas manager, who, it is insisted, should have a scientific as well as a mechanical training. I think, after the very clear exposition we have had to-day, that the West of Scotland Association might take up the question of establishing a college in Scotland, and appointing Mr. Young to a professor's chair. It is evident that the enemy is at the door, and that men like Mr. Young are required to fight the battle. To revert for a moment to the remarks make by Mr. Young, I must say that I have always held the popular idea, although I am not a gas manager, that the whole result of the increased yield arose from the greater surface. Mr. Young has given the scientific idea and the true exposition, and he has given to us simpler people the very good rule of scraping the retorts. No one can find any difficulty in that, and yet, by not attending to it, very serious results will doubtless be produced. I must say, as a non-scientific man, that I was delighted with the paper.

The Chairman—It is a great misfortune that these improvements are not appreciated as they ought to be. I think, too, besides the education of managers, there is a crying necessity for the education of proprietors, because, whenever there is some slight hitch with new apparatus, the whole invention is pooh-poohed, and there is no hesitation in ordering its removal. I think it would be a great blessing if proprietors of gas works would appreciate those improvements, and recognize the status of men who devote so much of their time and attention to them. It would be better if wo could get them educated up to that point.

The motion was then unanimously agreed to.

The Drying of Coal.

Mr. Henry Aitken (Falkirk) said:—

I regret that, as the results which the paper I was to have read have not been checked, I must forego the pleasure of submitting it to this meeting. I would have read it to you, as pointing to a step in the right direction, namely, the urgent necessity of purifying gas so completely from sulphur as to make it to be preferred before all other means of illumination. The extraction of the sulphur compounds from gas, particularly in England, has caused a great amount of expense and trouble, and the results have often been anything but satisfactory. Although the sulphuretted hydrogen is extracted, the amount of sulphur remaining has been ascertained to be from 10 to 16 grains per 100 cubic feet in Scotland, while in England it is often twice as much. It is of importance that we should extract every particle of these sulphur compounds, but as I hope to have the results verified very shortly, I will not now enlarge upon this matter.

With your kind permission, therefore, I would draw your attention to the subject of drying coal. I have not had time to prepare a paper, but I have been thinking over this subject, and making experiments, and will give you my thoughts simply as they occur.

Our Scotch common coal contains from 3 to 18 per cent. of water; that is, water that can be expelled by heating the coal up to 212° Fahr. Our Scotch cannel coal also varies considerably—viz., from 1 to 10 per cent. It is a notable feature that in one seam the percentage of water varies at different places in the workings. I have seen it vary something like 6 per cent. within a couple of miles. Of course, when a new field is opened there is more water than when the coal has been lying dry with mines through it, because the air passing through the workings extracts the vapor, and so there is less water left in the coal. In drying the coal the object I had in view was not directly bearing upon gas making. I wanted to dry coal on a large scale, so as to make it more suitable for furnaces. The modes I adopted were to put the coal first into vessels heated up to a temperature of 214° Fahr., and then into chambers through which I passed the exhaust steam, or steam at high pressure. I also passed gases from a flue mixed with air to 214°, and also heated air up to 214° through the coal. Thus, by keeping the temperature at from 212° to 214° for a considerable time, I expelled nearly all the water in the coal. In this process one curious thing takes place: after extracting the whole of the water from the coal you find that the moment you dip it into water again it absorbs as much water as it contained before it was dried, so that, if you intend to use coal dry, you must use it whenever you take it from the drying chamber, and not give it an opportunity of again absorbing moisture.

The effect of drying coal is to make it more friable and more easily broken up, though with parrot and splint coal this is not so marked. The way in which they break up depends upon the temperature to which they are exposed in the chamber, and the rapidity with which the heat is applied. The effect on the burning of coals that have been dried is very marked. You take some of the dried coal and place it on a fire on which there is no green coal. There being no aqueous vapor, the gas burns at once, and there is a remarkable absence of smoke. You frequently her people complain of coal being smoky. I think that smoke results very much from an excessive quantity of water in the coal. At least, I have found on experiment that coal with much water in it has a tendency to deposit more smoke on kettles, this being caused by the imperfect combustion of the gases, through the presence of the aqueous vapor.

The effect on the coke made from dried coal is very remarkable. Take, for instance, the Ell coal of the Hamilton district, as worked; charge it into a retort, and you get out a spongy mass. On the other hand, charge the retort with dried coal, and the coke comes out in pieces almost of the same size as the pieces of coal put in—hard, lustrous, and in many ways in a better state for several purposes than more friable coke.

The effect of drying parrot coal before making it into gas is worthy of attention. I have here an analysis, by Dr. Wallace, of Provenhall cannel coal, dried and undried. These experiments have been made with his experimental apparatus. I shall read the one as against the other, and you will notice the difference. This coal I had great difficulty in drying. It contains, when taken out of the pit, 5½ per cent. of water, and after keeping it for a long time at a temperature of 214°, I was only able to reduce the water by 3 per cent. There was thus left in the dried coal 2·22 per cent. of water. The analyses are as follows:—

Report on the Provenhall Cannel Coal, by Dr. Wallace, F.R.S.E., F.C.S., Gas Examiner for the City of Glasgow.

I have made a careful chemical analysis and practical assay of an average sample of the Provenhall cannel coal, received on the 21st of January, from Henry Aitken, Esq., Falkirk, and have obtained the following results:

Analysis.

Volatile Matters.	Undried.	Dried.
Gas, tar, etc.	37·26	39·78
Sulphus.	0·27	0·20
Water at 212° Fahr.	5·34	2·22
	42·87	42·20
Coke.		
Fixed carbon.	42·12	42·40
Sulphur	0·33	0·24
Ash	14·68	15·16
	57·13	57·80
	100·00	100·00

Coke (dry) per ton of coal, 1,280 lbs., or 11 c. 1 q. 20 lbs. ..... 1295 lbs. or 11 c. 2 q. 7 lbs.

Analysis of the Coke (Dry).

	Undried.	Dried.
Carbonaceous or combustible matter.	73·73	73·35
Sulphur.	0·57	0·42
Ash	25·70	26·23
	100·00	100·00
Specific gravity of the coal.	1·390	1·287
Weight of a cubic foot in pounds	87·000	80·000

Practical Results.

	Undried.	Dried.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer.	10,250 cu.ft.	11,325 cu.ft.
Illuminating power in standard sperm candles by Union-jet, consuming 5 cubic feet per hour at 5-inch pressure.	25·22 cand's.	26·05 cand's
Value of 1 cubic foot of gas in grains of sperm	605	625
Equivalent of a ton of coal in pounds of sperm candles.	886	1,011
Durability of 1 cubic foot of gas by 5-inch flame.	53 min.	54 min. 30 sec.

Gravity of the gas, air=100.....	506	517

Remarks.

The above results show that this sample of the Provenhall coal (which was well cleaned) is of about the ordinary quality, except that the ash is a little higher than usual. WM. WALLACE.
Jan. 31, 1878.

This coal gives a large yield of good gas but the coke is of rather inferior quality.

(Signed)

WM. WALLACE.

May 14, 1878.

Chemical and Gas Laboratory, 138 *Bath St., Glasgow.*

The marked increase in the sperm value is very extraordinary, but I suppose we should make less tar, and therefore more gas, owing to the temperature being higher. Possibly the explanation that Mr. Young gives of the conditions of gas accounts to a very considerable extent for this; but on one point I think the drying of the coal would be injurious. I apprehend that the amount of sulphur compounds in the gas from the dried coal would be largely increased. That point I have not yet fully investigated.

In looking at the drying of coal you must not confound it with the keeping of coal. It is a very different thing. All coals lose much of their value in keeping. Take the Boghead coal, which is said to stand keeping better than any other. I have ascertained by analysis that it loses 25 per cent of its sperm value in 15 years when kept outside. I know that other coals lose considerably in shorter time; but I have no other reliable analyses with proper data to go upon. No doubt they do lose their value rapidly, particularly splint and common coals, and I have known shales lose from exposure quite as much as common coals. Indeed, I once knew a gentlemen who lost a good large shale field from want of knowledge on this point. He took for analysis some shale from the part where it was exposed to the weather, and the result not being good, but, on the contrary, very poor, he declined to have anything to do with it, and now this same shale is being worked up by one of the most successful oil companies in Scotland.

This about exhausts all I have to say on this subject at present.

The President—We all know that the longer we keep coal the greater is the quantity of dross that accumulates in the stores, and the reason for that is perhaps their becoming more friable through the drying. It would appear, from what Mr. Aitken has pointed out, that there is a great advantage in having the coal dried before using it. In practice, we can all confirm the truthfulness of this experiment.

Provost Sturrock (Kilmarnock)—I think it would be satisfactory if Mr. Aitken would tell us whether these are the results of experiment, or merely a popular idea that coal depreciates by keeping, because I have always been of opinion that coal is indestructible, and while exposure does disintegrate it, still the chemical parts remain unaffected. Perhaps Mr. Aitken will say whether he got these notes from actual test, or simply from popular opinion on the matter.

Mr. Young—I have listened with great pleasure to Mr. Aitken's remarks. I can quite understand how it comes about that when coal is dried before being carbonized there will be an increase of sulphur compounds in the resulting gas, because we know that when iron pyrites—a substance contained, more or less, in all coal—is distilled in the presence of watery vapor, the sulphur is principally eliminated as sulphuretted hydrogen; whereas, when distilled in the presence of dry carbon or carbonaceous gases, bisulphide of carbon, one of the sulphur compounds is produced, which are difficult to remove, and this is the form in which sulphur is usually present in ordinary coal gas. We further know that if we pass bisulphide of carbon, in the presence of steam, through hot tubes, it will be decomposed, and there will be produced sulphuretted hydrogen, a sulphur compound quite easily removed. The drying of the coal would, in my opinion, have another effect, which would be still more adverse to the interests of gas companies, at least financially; for unless they supplemented the present process of carbonizing by passing steam through the exhausted charge, the quantity of ammonia would be largely reduced. In the works where I am engaged we regularly introduce steam into the exhausted charge inside the retort, in order to increase the yield of ammonia; indeed, I may say it is a well-known fact to the manufacturers of paraffin oil, who use steam to wash out the oil vapors from the retort, that although the presence of the steam is injurious to the oils themselves, yet it has the effect of largely increasing the yield of ammonia—sometimes to the extent of from 50 to 100 per cent. Some years ago I remember making a number of experiments with another gentleman engaged in the oil trade. These experiments were made to test the utility of a retort for which I had obtained a patent, and which he proposed using in his works. One of the great drawbacks to this form of retort was that, although it gave a large yield of oil, it gave but a very low yield of ammonia. It occurred to me, in these circumstances, that the nitrogen, or the compounds containing it, might be fixed by the residual carbon, and by the alkalies present in the shale residue, in a manner similar to that by which cyanogen is held by alkali in the presence of carbon. But whatever may be the form in which it is fixed, this I know—that the moment steam is passed through the exhausted charge, the ammonia is liberated, the water being decomposed, the oxygen combining with the carbon to form carbonic oxide and carbonic acid, and the hyrogen combining with the nitrogen to form ammonia. Then, with reference to the stability of the coal, I may say that at the works with which I am connected there is unfortunately associated with the shale which we work a rather low class of coal, which we are compelled to raise from our pits along with the shale. This coal rapidly loses its heating power when exposed, containing, as it does, a considerable quantity of iron pyrites. This compound rapidly undergoes chemical changes, which cause the disintegration of the coal. A brig of coal which had been left lying for a few years, we found, from this cause, to be almost useless as fuel. But we have further proof that not only are the foreign substances in the coal oxidized, but we have every evidence that the elements constituting the combustible part of the coal itself are oxdized, as evidenced by the quantity of choke-damp, or carbonic acid, given off by some coals. Further, we have evidence that the carbon and the hydrogen of the coal may combine to form a gas, as evidenced by the fire-damp, and by the quantity of inflammable gases given off by coal when stored in close vessels. We all know that coal, when stored in the holds of vessels, should be properly ventilated; and we have had an instance of the deplorable results arising from neglecting to take this precaution, in the recent explosion which occured in one of our Atlantic-going steamers. I think, gentlemen, that these remarks would indicate that coal, by being exposed to the atmosphere, undergoes deterioration, not only by the oxidation of the foreign matters contained in it, but also by the gradual decomposition of the elements of the combustible portion of the coal itself.

Mr. Aitken—In answer to the question as to the deterioration of coal, I may state that my remarks were based on experiments made with Provenhall and Boghead coals; but I have also to say that those remarks were dictated by practical experience as well as by the results of analysis. I may state that in charging a blast furnace, whenever we are forced to go to the stock for coal, the regulation order is to increase the size of the charge according to the time that the coal has been stored. We find that we get an equal quality of iron from the same kind of coal by using a larger quantity. Coal that has been stored for some time is not so valuable for heating purposes as when it is used fresh from the pit. It is well known that many coals, when taken from the pit, give off to the atmosphere a large quantity of marsh gas, and a little carbonic acid gas.

CHARGING CONSUMERS OF GAS WITH DEPOSITS.

Mr. James McGilchrist (Dumbarton) said:—

Mr. President and Gentlemen—Although the remarks I am about to make will not ventilate any of the many great improvements that have been and will be made in the manufacture of coal gas, before it is superseded by the electric light, I know they will be profitable if I can only show how to increase the profits on the gas registered at comsumers' meter, by advocating, and causing you to adopt, the system of requiring deposits from all consumers. This practice has not, to my knowledge, been discussed before at a meeting of gas managers, and, besides having the merit of being new, it will doubtless give rise to an interesting discussion.

The question of consumers' deposits is one of considerable importance to the majority of the members of this Association, who have not only the manufacture and distribution of gas to superintend, but also the collection of the "bawbees" to vex themselves with. Therefore, without farther apology for bringing this subject before you, I will begin by remarking that the systems adopted by companies and corporations with regard to their consumers' deposits are as varied as the salaries they pay their managers. If you admit this, I shall have litttle difficulty in convincing you that both have great room for improvement, more especially the latter.

The Journal of Gas-Lighting has more than once referred to the advisability of charging money deposits from all consumers, and giving a fair percentage in return; but at the present time every company and corporation has a system peculiar to itself, which, unfortunately, in most cases is attended with very unsatisfactory results. In one town deposits are only charged from suspicious persons; on the principle that is, I fear, too often adopted, of judging the man by the coat he wears. This, besides being a poor test of a man's honesty or ability to pay, is harsh—nay, unjust. Why tax one consumer and not another? If we have a monopoly, we should not abuse it by favoritism. It is not proper that a manager or collector should be placed in the position of judging between man and man. He must make many mistakes, for who can tell, without previous experience, the just from the unjust? Besides, such a position is apt to endanger the managers' popularity. In another town deposits are only charged from consumers who occupy houses of one or two apartments. On what argument this system is upheld I know not; but I know it causes a great amount of dissatisfaction among the consumers who pay deposits. The argument proceeds thus: "Why do you not charge my next-door neighbor a deposit?" Gas man: "Oh, you know, we must draw the line somewhere." "Why draw it between me and my next-door neighbor?" the consumer replies. "Am I not as honest, &c., &c., as he?" And so the footing between gas maker and gas consumer becomes, as time roll's on, bitter and more bitter, and the bad debts accumulate, through consumers who live in houses of more than two apartments failing, removing, or some other cause; and the consumers who pay deposits are compelled also to pay a proportion of these bad debts, not only in an increased price for gas, but from the interest the gas maker has on the deposits. I could go on enumerating a dozen other systems founded very much on the same unsatisfactory basis as those already mentioned; but I have said enough. You know them all as well as I do. Gentlemen, I cannot think a company or corporation are doing their best for their consumers, unless they require deposits from all. Without this, you simply allow the one consumer to pay the other's debts. In a tailor's or baker's business this is undoubtedly the case; but the toilor or the baker has the privilege of selecting his own customers. Seeing the gas maker has not this privilege, it is his duty to protect the public, and wipe

his bad debts from off his books. You will excuse me for supporting my argument by the following facts. (I may state that this paper is not written for publication, otherwise it might be thought that I was blowing my own trumpet.) In the first year's working of the Dumbarton Corporation gas undertaking (in 1873-74), when deposits were charged only as the manager thought fit, they had, at the end of their financial year, the 1st of August, about 4¾ per cent collected of the amount of arrears. This seemed to me to be an enormous sum, and in the following year I advised the gas committee to charge deposits from all consumers. The committee brought the question before the Town Council, who adopted a motion to the effect that all persons wishing to be supplied with gas must lodge deposits at the following rates: 5s. for a single apartment, 7s. 6d. for two apartments, 10s. for three apartments, 15s. for four apartments; larger houses at corresponding rates. The amount for shops and other places of business to cover four months Winter consumption. In the year 1874-5 we reduced the arrears to less than 1¼ per cent. At the end of 1875-76 we had about 19s. per cent. of arrears; 1876-77 we had about 10s. per cent. of arrears; and at the end of last year (1877-78) the system had worked so well that we had only £2 14s. 7d. of arrears, or rather less than one-seventh per cent. These results, gentlemen, in my opinion, speak volumes in favor of the system I advocate, and I have no hesitation in recommending every company or corporation who are troubled with arrears to adopt it, and I am confident they will obtain the same results. A little opposition would, in all likelihood, be raised to it at the first; but in a few months it would all be lulled to sleep, and when those who opposed it understood its object, they would say, "It is not a bad thing after all." We give 2½ per cent. interest on all amounts deposited for not less than two years; but I am strongly of opinion that the rate of interest should be raised to 4½ or 5 per cent., which would make the deposit a fair investment to consumers; and as the company or the corporation pay about the same rate for borrowed money, they would not lose anything in that respect, but gain that which at the present time is lost through consumers not having deposits. Besides, with deposits, the collector has not the same amount of trouble in hunting up defaulting consumers. In conclusion, gentlemen, if any of you think of recommending this system to your directors, and if it is introduced, never make any exception—not even of your provost or chairman. They furnish you with an excellent argument when any consumer is endeavoring to give a reason why he should be exempted. You reply that the provost had to pay his deposit, like any other consumers, and after this the customer will invariably ask, "How much?" I trust my few hurriedly got-up sentences will induce you to express your opinion on this subject of consumers deposits.

The President—Here is a subject of great interest to every one of us. We all want to do away with bad debts, as far as possible; at the same time, having a monopoly of gas, we should be careful not to make too harsh demands upon gas consumers. Companies are different from corporations. In the case of corporations, the gas works belong to the rate-payers, and a corporation can do certain things which will be for the public weal which a company could not do. Besides, the people would stand the imposition of laws and regulations by a corporation, when they would not recognize them if a company were to insist on them. I shall be glad to hear the opinion of the meeting on this question of taking deposits. No doubt it has its advantages, but many things that are advantageous are not always expedient.

Mr. Fairweather—One thing I am pleased with, and that is with respect to the interest allowed on deposits. I think that 4 or 5 per cent. ought to be allowed, so that companies and corporations might be in the position of saying that they did not wish to make profit by such deposits. In my district, interest is not allowed—the principal merely being given up when a consumer leaves; so that the people come to the conclusion that the gas company make a great deal of profit out of the deposits, and this is very prejudicial to company. Now, this feeling would be remedied to a large extent by allowing interest. I am very pleased indeed with the tone of Mr. M'Gilchrist's paper.

Mr. Mitchell—It is now 20 years since our company adopted the system of deposits. At the outset the amount fixed was 5s. for each depositor, and no interest was allowed. In 1878 the amount was fixed at 7s., without interest; and in 1887 the sum was still 7s., no interest being allowed; but if the consumer lodges 10s. he gets interest at the rate of 5 per cent. This interest, however, is only given when the money has been deposited for six months or more. The system has been beneficial to the collector. Our deposits range from 5s. to £5, and I may state that consumers prefer to leave 10s. deposit and get interest, rather than 7s and have no interest.

Mr. Bodie—I think the principle of taking deposits is wrong altogether. If I were to ask for a deposit from a gas company, for work which I might be employed to execute, offense would probably be given, and business might be ended. In doing business we trust people, and if we find they are suspicious characters, we insist upon security. Why should a gas company be in any other position? I think the imposition of deposits is unfair to people who cannot at the moment pay their way. They are asked to pay for a thing which they do not possess.

Mr. Nelson—For one I quite agree with what my friend Mr. Brodie has said. I do not see why companies should occupy an isolated and preferential position over other people. The fact that they have a monopoly in the supply of certain articles should make them more generous, and I think it is ridiculous to charge deposits, more especially as it bears so heavily on the honest poor consumer. It is a serious matter for a laboring man who occupies a single apartment, and who has a severe struggle to obtain the necessaries of life, to be forced to pay 5s. or 10s., as the case might be, before he can get gas. He may not be prepared to lay out that amount. In another sense it is a great disadvantage, inasmuch as it operates materially against the general diffusion of gas throughout a city, more particularly a manufacturing city, when there is so large a proportion of small houses. In charging deposits, I think that companies stand in their own light. In my opinion they ought rather to offer inducements to poor people to take the gas, as they do in the North of England. I know also that for every shilling companies lose by poor people, they lose ten pounds by those professedly rich people who dwell in mansions. Therefore I think all gas managers should set their companies against the adoption of such a system.

Mr. Fullerton—In my opinion, the discussion of this question is out of place in a meeting of this kind, seeing that it is a mixed body—there being parties here representing both companies and corporations. I do not think the question should be discussed on its merits at all, because in places where the works are liable to be taken over by the corporation, it would be difficult to put the system in force. It would be much better to leave every one to manage his own business.

The President—We could scarcely expect to be unanimous on any matter; but I think this is a subject fit for discussion, because where parties differ we come to hear both sides of the question. I coincide very much with what Mr. Nelson and Mr. Brodie have said.

Mr. Renfrew—I beg to differ from Mr. Nelson. So far as the paper goes it makes the charging of deposits universal. Mr. Nelson takes it up as if the deposit were only to be charged from working men, while the rich were to be exempt.

Mr. Nelson—I did not say a word about exempting the rich. On the contrary, I should insist on their being charged deposits in preference to the poor.

Mr. McLeod—This is one of the subjects with respect to which our sympathies would go with persons holding views opposed to those of Mr. M'Gilchrist; but our practical views are in his favor. We must deal with human nature as we find it, and we have two alternatives—al least in a large district such as Glasgow. Perhaps in a dull time like this you would find that there would be fewer meters taken up by the poor people if you were to insist upon these deposits; but, at the same time, I would certainly go against the principle of insisting upon deposits, were it not that by getting the poor people to deposit 5s. or 10s., and giving them, say, 5 per cent. upon their money, you teach them an important lesson in social economy.

Mr. Jeffrey—I have had very little experience in the way of deposits. I do not suppose that Mr. Brodie has lost much through his dealing with gas companies; but if he had to manage gas works and not take deposits, he would find it a different thing at the end of the year. I would not require deposits from all parties. Our plan is to charge new consumers until we know them, and after that they can be paid back, say in twelve months or two years, as the case may be. I should be in favor of deposits, but not from every person.

Mr. Monk—There seems to be a great variety of opinion as to the question of insisting upon deposits. Some companies take deposits and give no percentage upon them, and others pay from 2 to 5½ per cent. While this variety of feeling has been expressed, we must all sympathize with Mr. M'Gilchrist on the object he has in view. If deposits are to be levied at all, there should be no distinction whatever made—no respect of persons. There are a great many reasons why there should be deposits, and those who have to do with the collection of accounts will understand that as well as I do. In the case of Lanark, if we were to insist upon the enforcing of the deposit system, we might put an end to more than a third of the consumption. As it is, in collecting our accounts the loss is never more than 15s. or 16s., and sometime as low as 14s. per cent. No doubt a great deal of trouble is incurred which the deposit system might obviate, and it might be introduced where it would be considered an advantage; but this very much depends upon the trade of the town. It might do very well for a flourishing place like Dumbarton, but it would never do in a place like Lanark. I think the discount system is a preferable one.

Mr. Dalziel (Kilmarnock)—This question has been under the consideration of our committee, but there seems to be a feeling that the insisting on a deposit would bear very hard upon the poor, but there is not the slightest doubt that it would be a great advantage to the collector. We have 3,000 or 4,000 consumers, burning something like 14 millions, and other 1,400 consumers, who burn something like 28 millions. If we were to insist upon a deposit, I am afraid it would very much reduce our collection. Now, our average loss upon collection does not amount to one-half per cent. I think we should only take deposits from strangers. If you have a vigilant collector you will not lose much. While I think the deposit is a security to a company, still to insist upon it would bear hard on poor people.

Mr. Fairweather—I think the general opinion is that deposits should not be charged from consumers who are already in the town, but from new customers, and that they should be required, I presume, from rich and poor alike. I do not think any one is making a great sacrifice if he leaves a deposit, provided he gets five per cent. upon it. It is the duty of companies and corporations to see that rules are laid down in regard to the deposits, because corporations only exist in the interest of the public. I think the deposit system is the best means of obviating bad debts.

Mr. Richmond (Whitburn)—To me the discussion seems to have been consumers *versus* private companies. I can hardly agree with Mr. Brodie and Mr. Nelson that it is wrong in principle to charge deposits from a consumer when he wants gas; but I think it is unjust to working men, who have not the money

to spare. The only redeeming point about the system is that 5 per cent. is given upon the deposits. If deposits are exacted, they should be upon the whole of the consumers. I object to the statements made by Mr. Brodie. If a gas company requires work to be done, I do not see that a deposit should be insisted upon from it. I should take the work, and consider the company good for the amount. I do not think it is right that it should be left to the manager to say whether deposits should be charged.

Mr. M'Gilchrist—I am obliged to the gentlemen who have expressed their opinions in regard to my few remarks. I did not come here supposing that they would be wholly agreed to. I brought the subject up for discussion, in order that we might determine which was the right side, and I think that the majority of the persons present do not agree with Mr. Brodie. He thinks the system a mistake. I am astonished at this, because he has been dealing with honorable people since he started business. Had Mr. Brodie suspicious parties to deal with, I am sure he would say, as he said of the doubtful person, "Get security." The great advantage of making deposits general is that the manager or collector is not bound to make invidious distinctions as to who should or who should not pay deposits; because, when all are made equal, no one can complain. Mr. Richmond would charge rich people, and let the poor people off. That whould be a mistake, because it is through the rich and large consumers that we are able to sell to the poor at a lower rate. If the system of not charging deposits from each individual were adopted, the rich man might come and say, "I have as much property as would buy the whole of your gas works;" and if he were allowed to go free, the poor man would undoubtedly complain. I have replied to all, that the deposit is a very small matter, and it is for the benefit of the consumer that it is made; because if the deposit were not insisted on, there would be an increase in the bad debts, which consumers would be required to make good. Altogether, I do not see how we can get out of the difficulty without charging deposits from all consumers. Mr. Fullerton did not consider that this was a question that should be discussed here, because there are so many different opinions; but I think it is just as well that every one should express his individual opinion. I heartily agree with Mr. M'Leod that we are teaching the people social economy if we charge deposits and give a percentage on those deposits. He is a very poor man indeed who is not able to leave 5s. or 7s. 6d. on deposit, with the prospect of 5 per cent. return. I can not see how it is a hardship for any man who uses gas to leave a small amount as security. No doubt a great many people agree with Mr. Jeffrey that it is correct only to charge new tenants; but, unfortunately, it often happens that people in good positions come down, and the company suffers serious loss, so that argument will not stand. As to Mr. Richmond, he can select his consumers; but, unfortunately, gas manufacturers have to take every one. I have to thank you for the way in which you have listened to my remarks, and to say that if you charge deposits you will all agree that the system is sound in principle and correct in practice.

The President—I beg to move a hearty vote of thanks to Mr. M'Gilchrist. In conclusion, I have to say that we have been indebted to Provost Sturrock and the town council for the use of this room. I therefore propose that we accord them a vote of thanks for their kindness.

PLACE OF NEXT MEETING.

It was agreed that the next meeting of the Association should be held at Coatbridge.

On the motion of Mr. Mitchell, a hearty vote of thanks was accorded to Mr. Stewart, and the proceedings terminated.

In the afternoon the members of the Association dined together. The president occupied the chair, and the duties of croupiers were discharged by Messrs. Nelson and Brown. A very pleasant evening was spent.

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—ED.]

The Future Education of the Gas Manager.

Mr. Editor: The future education of the gas manager is a subject which has of late received a great deal of attention, and a great many able letters have appeared in the London *Journal of Gas-Lighting* bearing upon the subject.

Hoping that other and abler pens will take up the subject, I trust I may also be able to show that the scheme I have before proposed through your JOURNAL, viz,, the formation of an association of assistants, will be an important aid in rendering the gas manager of the future equal to any crisis that may occur.

In the first instance, I will endeavor to take a slight glance at some of those men who figured prominently in the starting of the gas business.

While, for the practical adaptation of the Laws of Nature to the lighting of streets and houses by gas, we are indebted to practical men; still it must not for a moment be forgotten that to men of science, philosophers, physicists, and chemists, we owe the discovery of such laws.

What profession can reckon in its ranks of pioneers such eminent personages as ours?

Van Helmont, the first to discover that a different result ensued, if bituminous substanres were burned in a fire or distilled; and while he could not have, and did not forsee, the possibility of such a discovery ever being made of practical use; yet even his distinguished name can justly be associated with our profession. But time does not permit me, nor is it necessary that I should do more than mention the names of some of those men who, in their works and researches, have left monuments behind them—landmarks which will always be held in view by all those who pursue any profession in any way connected with the sciences.

To Dr. Clayton, Watson, Lobert Boyle, Priestley, Cavendish, Lavoissier, Scheele, and Black, is our profession indebted for their valuable researches and practical experiments. Among these those who were not chemists by profession experimented exclusively in that science.

To Priestley are we indebted for the discovery of carburetted hydrogen, and oxygen, and for many discoveries in the science of pneumatic chemistry. Cavendish was noted not only as a chemist, but also as an electrician and mathematician.

But it is useless to eulogize the names mentioned by citing their works. Their names are their own histories. Suffice it to remember that these were all men eminent in their scientific pursuits.

For the practical application of the discoveries made by these scientists we are indebtad to William Murdoch, who first made use of gas in 1792.

It is a source of regret that we have not more information concerning this gentleman at our command than what we possess. The fact that he was an assistant of Jas. Watt, Jr., and the knowledge of the chemistry of gas-lighting which he showed he possessed, proved him to be not only a thorough practical man, but also one well up in the science of his day; and it must be borne in mind that scientific knowledge was not so easy to acquire in his time as it now is.

If Murdoch had remained connected with the profession he formed, there is little doubt but that he would have remained its most shining light. Winsor was one of those persons whom it is difficult to decide whether great praise is due, or whether censure should be passed upon him. For his great perseverance, his fighting the hardest when the most difficulties beset his path, and his thorough determination to accomplish his object, great praise must be accorded him. For his ignorance, and his wild and extravagant statements, we cannot but censure him.

But that he formed the first gas company cannot be gainsayed If he had been as freely gifted with discretion and practical common sense as he was with perseverance and energy, he would have left a name second to none in the profession; and that company which he formed would have begun under better auspices.

As the name of Winsor disappears from the history of gas-lighting, the name of Samuel Clegg appears in its place. Clegg succeeded in his management of his company because besides being thoroughly conversant, for one of his time, with the science of his business, he was also a thorough practical man. He was able to supply the many wants that arose; and more, he was a mechanical genius. How assiduously he must have given himself to his work to produce, in the short time he did, so many and so (comparatively speaking) perfect machines,

Accum was a chemist; and while his knowledge of chemistry would be a great aid to one having the management of the first company, his lack of practical knowledge unfitted him for the managers' office. So Clegg's succeeding where Accum failed is easily explained.

The directors of the Chartered Company made a great mistake in supposing that because chemists made the first discoveries in regard to gas-lighting, a chemist could successfully form a company in the face of so many and so great obstacles.

John Malam was another Clegg. I have mentioned only some of the most prominent names; but enough I think to form a fair judgement of the question; and it would certainly appear that those who possessed scientific knowledge, combined with practical ideas and sound common sense, were the ones who succeeded the best.

Thus it would appear that a gas manager wants to possess not only a thorough knowledge of the routine of a gas works, practical mindedness, executive ability, and last, but not least, a technical education. It would seem the height of folly to suppose that a manager of a business so intimately associated with science, as the gas business is, could administer his office intelligently, without at least a fair knowledge of the sciences.

The gas business hinges on chemistry; and while it would rarely happen that a chemist would be able to cope with the practical difficulties which a gas manager daily encounters; yet it is equally true that a gas manager who does not possess a knowledge of chemistry is working very much in the dark.

I would now endeavor to deal with the *slim* of the correspondence before alluded to.

"Isca" sets the ball in motion. His letter is a very able one, and shows its author to be one thoroughly acquainted with the gas business. I must agree with this writer that there has been very little substantial improvement in the gas business during the last twenty years. Each one has pretty much followed in the steps of his predecessors, and has accepted too frequently the opinions and conclusions of others as correct, without attempting to verify them of his own knowledge. This would hardly have been the case if managers had possessed a greater technical education, and had been given more time, free from the ordinary routine of the works experimenting. This last is a very important item; for, in many cases, so much is thrown on the shoulders of the manager that he has no time to spare from his regular work. This is the fault of the directors, who should employ enough help to relieve the manager of a great part of the routine work, and thus raise the standard of the profession. I am inclined to give a great deal of credit to one who has risen from an humble sphere to that of the head of a works. For such a person must have studied diligently to have so risen. True, he must have done much studying before he reached the same level with many of his brethren; but the experience which he has brought up with him from the lower positions compensates for this. Be-

sides, there is nothing I can see to prevent such a one, having worked up his way so far, to continue his studies into the more interesting, but less trodden, field of mathematics and science. Having done so, is he not eminently fitted for his position?

I cannot but believe that the number of those who, having risen from an humble sphere to one of great trust and responsibility, would not educate themselves up to the requirements of their position, is very small. Perhaps, when the scientific nature of the process of gas-making is taken into consideration, it must be conceded that a goodly portion of gas managers are deficient in technical edcation. If so: then the question is how can it be remedied?

In answering the question it must be remembered that there are two classes who must be taken into consideration; those who are already managers, and those who are so only in expectation—the assistants.

I certainly feel that some of the schemes proposed by our English brethren could be successfully carried out in this country. What is needed is means which will induce the managers to acquire that technical education which I have endeavored to point out as so necessary. There have been several plans proposed.

The creation of an extraordinary class of members to the Association.

Competitive examinations.

Examinations and awarding of the certificate of the Association.

Medals, as the reward for the best papers.

Each of these plans may have some objections, but they all have much good in them.

The creation of an extraordinary class of members would seem feasible, and the granting to such members the certificate of the Association. This would as nearly meet the case as anything could. The requirements for such membership should be: A thorough knowledge of the gas business, and scientific and mathematical knowledge: to which should be added, as a requirement, a service of at least five years in a gas works. The examinations to be conducted by an examining committee of the Association asssisted, if deemed necessary, by an eminent professor.

Competitive examinations. These would consist or yearly oral examinations, awarding a first, second, and third certificate to the three highest contestants.

In the examination and awarding of the certificate of the Association, The examination could be conducted as in the examination of members for extraordinary membership, with the same requirements, only having them open to all persons who have served five years in a gas works—either as manager or assistant. The granting medals to the writers of the best papers read at the meetings of the Association, would be the most simple plan; and while it might not result in as much good as some of the other plans, would, nevertheless, be very beneficial. Any of these schemes would, I feel, result in much good. The creation of the class of extraordinary members would seem the most desirable. They would all supply a stimulus for study, research and experiment. And, never mind how worthy the person is, where there is an object to work for there the most work will be done.

We have now the other class to deal with, viz., the assistants.

Much good would result from the formation of an assistants' association I firmly believe, for there is at present a most conspicuous absence of any stimulus for an assistant to apply himself diligently to study. To my mind it is not whether an association should be in the form of a separate Association, or a class of junior members to the regular Association. If there was a separate association, with its meetings held at a different time from the senior Association, the assistants would have a better opportunity to attend; while, on the other hand, they would not have the opportunity of meeting the members of the Association.

The Association, with its three classes of members, would undoubtedly do much good. There would be the incentive for a young man not to stop until he had reached the highest order. ASSISTANT.

Correction.

In the official report of the proceedings of the Western Gas Engineers and Superintendents Association, as printed in our issue of Oct. 16, the name of Mr. John Atkinson should have appeared as an honorary member, and the name of Mr. J. M. Armstrong as an active member. The clerk, in writing out the proceedings for publication, got the names transposed.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)

24 PINE STREET, NEW YORK CITY.

FEBRUARY 3, 1879.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid.	Asked.
Gas Co.'s of N. Y. City.				
Central	466,000	50	—	75
Harlem	1,800,000	50	27	35
" Bonds	170,000			103
Manhattan	4,000,000	50	160	170
Metropolitan	2,500,000	100	104	110
" Scrip	$1,000,000	...	90	95
Mutual	5,000,000	100	58	65
" Bonds, gold	900,000	1000	95	99
Municipal	1,500,000	100	100	110
" Bonds	750,000		95	95
New York	4,000,000	100	84	90
Nothern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	130
Citizens	1,200,000	20	55	60
" Scrip	320,000	1000	90	95
Peoples	1,000,000	10	20	30
" Bonds	325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	50	56
" Ctfs.	700,000	1000	—	90
Williamsburgh	1,000,000	50	80	85
" Scrip		...	88	92
Kings Co	200,000	100	—	70
Union Co. E N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	60	85
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N.Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	95	98
" Ctfs., gold	1,000,000		95	10
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	85	91
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			128	13
Cincinnati G. & C. Co.				190
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	114	120
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind.		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	120	125
Hempstead, L. I.	25,000	100	...	—
Jersey City	386,000	20	133	140
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown Maine	400,000	100	70	80
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede St Louis Mo.	1,200,000	100	—	75
Long Branch		20	30	40
New Haven, Conn		25	136	152
Peoples, Jersey City		...	—	80
" " Bds.				95
Peoples of Albany	650,000	100	10	17
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	44	48
" Bonds			106	—
Plainfield, N. J	80,000	100	—	105
Perth Amboy		25	--	95
Rochester, N. Y.		100	50	60

The Manhattan Gas Company, New York city, has declared a dividend of 5%, payable Feb. 1st. The Metropolitan Gas Company, New York city, have declared a dividend of 5 per cent., payable Feb. 11th.

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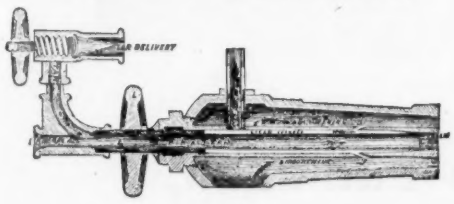

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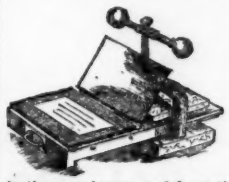

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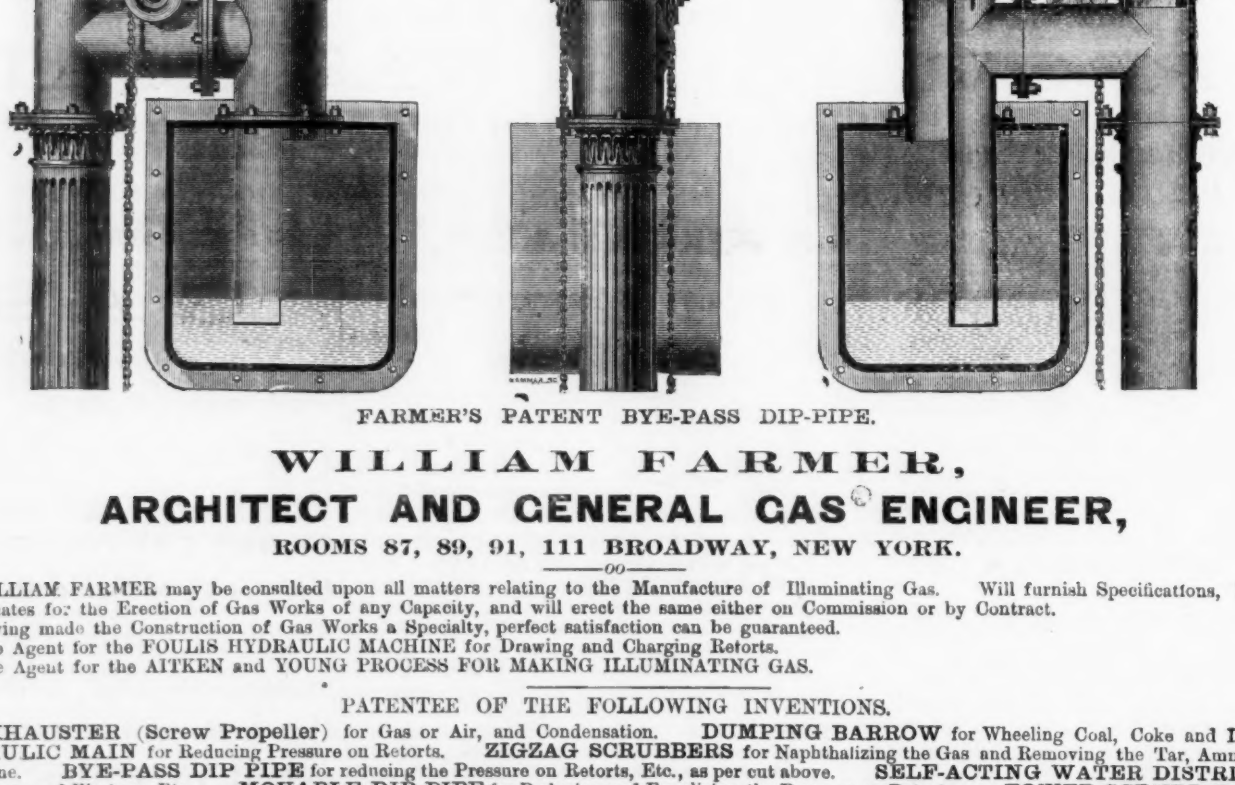

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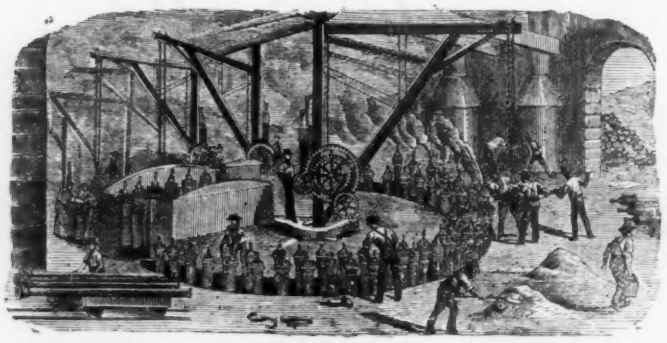

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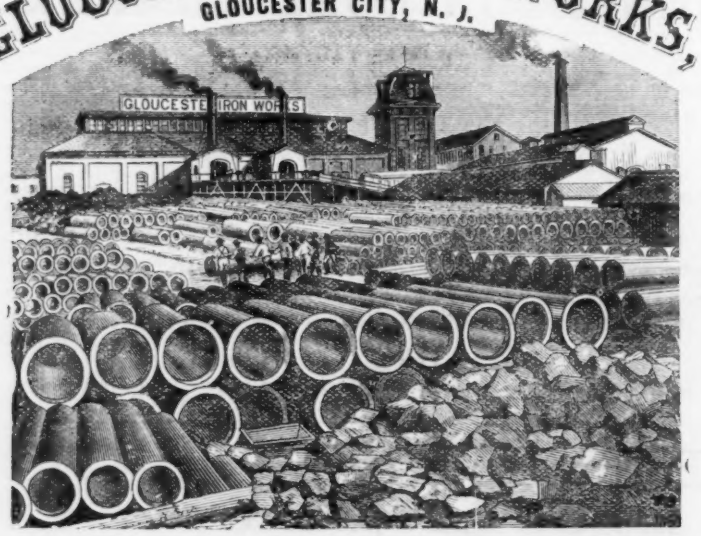

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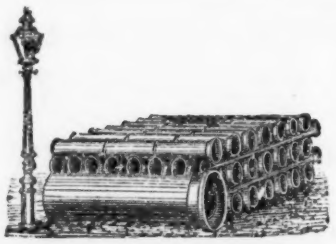

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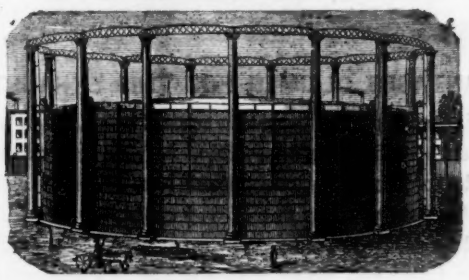

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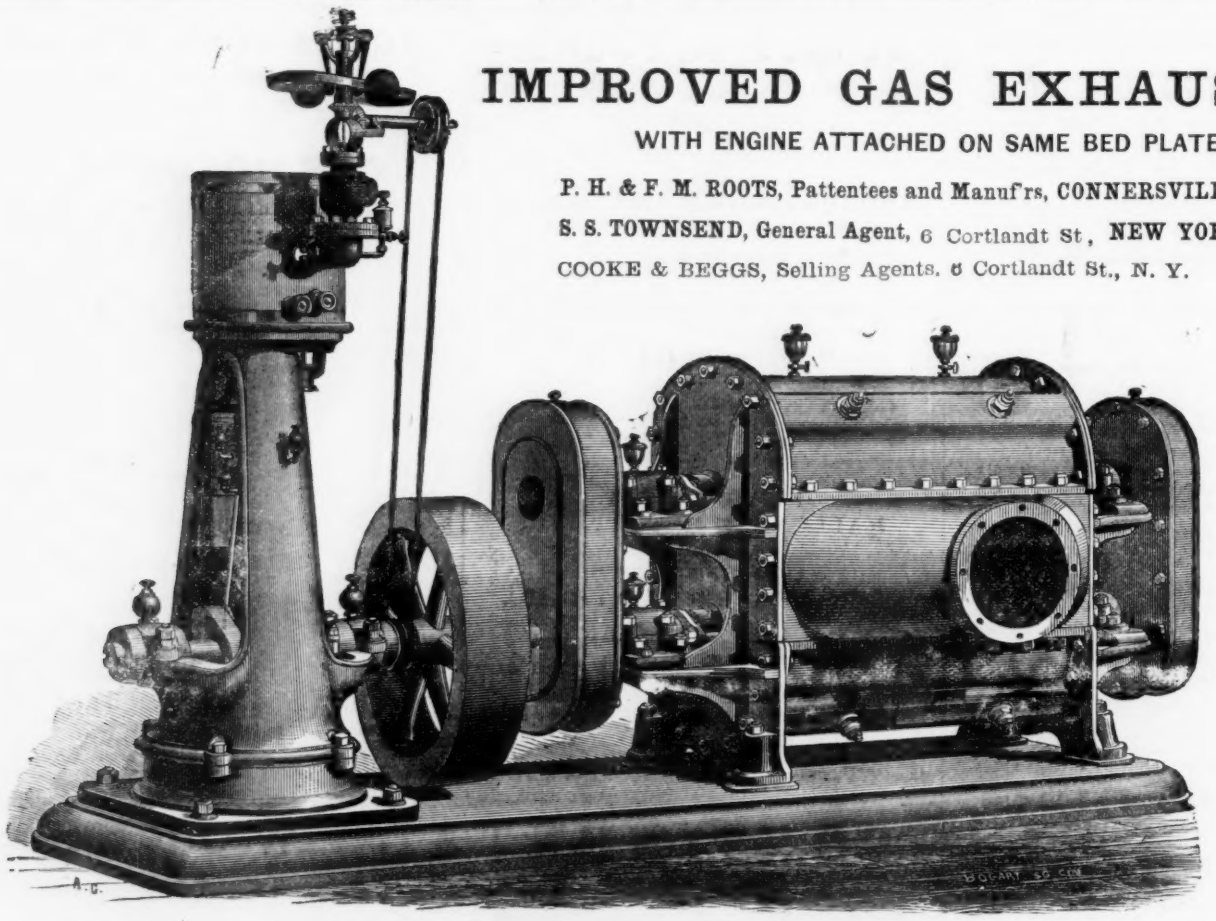

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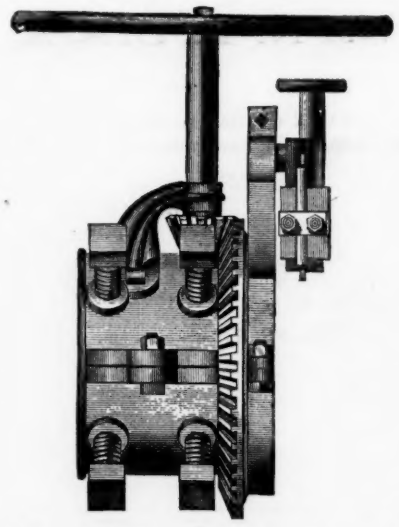

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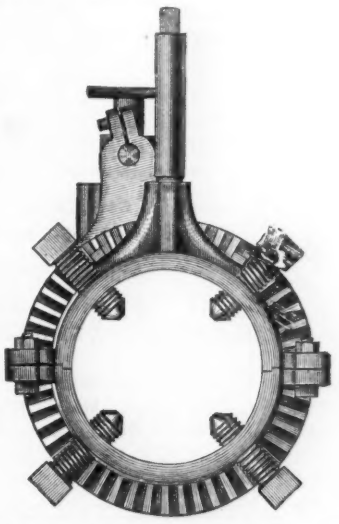

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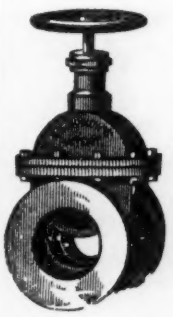

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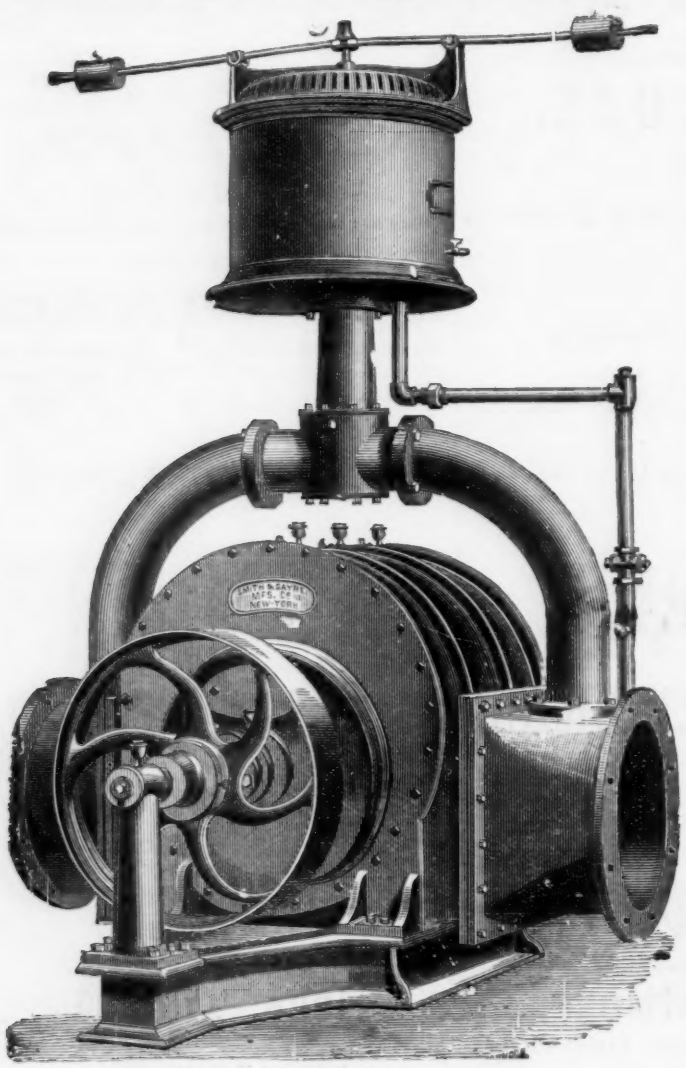

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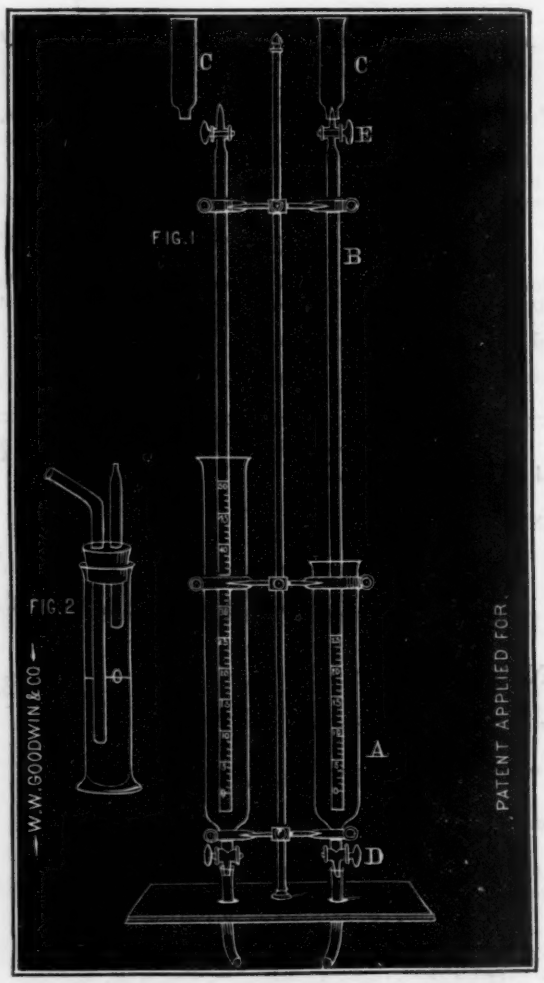

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